Project Appraisal Manual

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FOREWORD

An Overview of the Manual

The manual has been divided into three parts. Part I will focus on the theory and methodology of project development and appraisal (cost-benefit analysis); examples will be provided to illustrate many of the points. Users of this manual will hopefully go back and forth between the theory and the case studies to gain a thorough understanding of how to apply the principles of project evaluation to the analysis of investment opportunities in the public sector.

DRAFT, January, 2013

PREFACE

Why develop this manual?
The purpose of this manual is to help the Iraqi government implement the use of international best practices of Project Appraisal while approving a public sector project. It describes how public sector investments should be evaluated so that they may be taken from the idea stage to the implementation phase in a successful manner. These themes will be addressed under three headings: *financial, economic, and distributional* analysis of a project.

By their very nature, investment projects involve benefits and costs over a number of years into the future. Market prices and project outcomes cannot be predicted with certainty. In addition, technical difficulties and delays in implementation frequently result in cost and time overruns. Given this uncertainty, account must be taken of a project's risks and the costs that these risks create. *Risk analysis*, and how to reduce and manage risk through the use of contracting, and other risk mitigation methods, will constitute the fourth part of the manual.

What is the manual?
The manual is a supplement to training of those employees who are not familiar with the methodology of project selection using Net Present Value (NPV) criteria. It helps employees of the operating departments understand the methodology for viable project selection. The Manual contains an introduction to project appraisal techniques, a detailed discussion on financial, economic, stakeholder and risk analysis, and some practical recommendations on how to proceed.

When to use the manual?
Once a line ministry has decided to adopt this methodology for approving capital investment projects, this manual can and should be used as a reference book.

Who should use the manual?
This manual is intended for a number of users in all ministries which have capital investment projects. First, it serves as a guide to the public sector managers responsible for making public sector investment decisions. This group includes not only project analysts and decision makers within the ministries of planning and finance, but also those employed in the line ministries, and government departments and agencies that are involved with the formulation, evaluation and implementation of projects. Second, the Manual is meant to be used for training purposes by training institutions to educate and train the future managers in these states. Finally, it provides an assurance to the international development and lending institutions that the funds provided to the states will be spent in a responsible and productive way.

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How to use the manual?

The manual is most effective when combined with employing a competent consultant who can conduct training and provide technical assistance to department employees appraising the projects for the first time using this methodology. Accordingly, it is best used in conjunction with a formal implementation plan and training program. Employing specialists who have had experience with the approach would significantly augment implementing this methodology. Finally, there is a step-by-step guide and a checklist that can help assure that the process remains on track.

Chapter I: Introduction

CHAPTER I: INTRODUCTION

Purpose of the Project Appraisal Manual

The purpose of the *Project Appraisal Manual* is to help the Government of Iraq develop and evaluate investment projects to promote economic and social well-being. It describes how public sector investments should be evaluated so that they may be taken from the idea stage to the implementation phase in a successful manner. These themes are addressed under three headings: *financial, economic, and distributional* analysis of a project.

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What is a Project?

In capital budgeting, a *project* is the smallest, separable investment unit that can be planned, financed, and implemented independently. This helps to distinguish a project from a program that may consist of several inter-related or similar investments. While it is possible to treat the whole program as a project for the purposes of analysis, it is advisable to keep projects limited in scope and close to the minimum size that is economically, technically and administratively feasible. If a project approaches program size, there is a danger that a highly profitable component may mask an unprofitable activity.

In general terms, *project* refers to a great variety of activities that may range from single-purpose activities such as small infrastructure projects to more complex multi-part projects such as integrated hydro-electric projects with irrigation, power and tourism as its components. For the purposes of this manual, a

project may be defined as "an activity that involves the use of scarce resources during a specific time period for the purpose of generating socio-economic return in the form of goods and services." Thus a *project* may be viewed as an investment that encompasses not only the physical infrastructure facilities such as roads, irrigation canals and drinking water facilities but also development services such as agriculture extension, health and education.

Project as an "Incremental" Activity

An investment opportunity usually involves incremental net cash outflows or economic costs in the initial investment or construction phase followed by incremental net cash inflows, or net economic benefits, in the operating phase. An incremental net cash flow refers to the net cash flow, or net economic benefit that occurs with a project minus the net cash flow, or net benefit that would have occurred in the absence of the project. In this way, it is possible to identify the additional net cash flow, or net economic benefit that is expected to arise as a result of an *additional or new* investment through a project and to measure the corresponding change in wealth, or in economic well being that can be attributed to it.

Uncertainty and Contractual Arrangements

Although this is the standard view of a project, and one that will be analyzed in the chapters related to the financial, economic and distributive analyses it is not the complete picture. Uncertainty prevents an analyst from precisely identifying the time path of the net cash flows or net benefits. The best that can be said is that the anticipated benefits and costs are likely to lie in a given range with a given probability. Thus, the output of a project appraisal is more than just a point-estimate of a project's net return. A project evaluation should provide some assessment of the expected variability of a project's net return, the probability of a negative return, the cost of risk and who is likely to bear it.

Even with this information, the profile of a project is not complete. There is also a need to know and understand a project's contractual environment. For example, there may be alternative financing arrangements that would help to redistribute some of the risk and make a project more attractive. Or there may be contracts that project managers enter into with its customers/end-users or its suppliers. These different arrangements could also create incentives or disincentives that would encourage a project's participants to alter their behaviour and change the overall returns.

The effects of this uncertainty and the contractual arrangements are an integral part of project appraisal and are dealt with in the risk analysis part of the manual.

Chapter II: Project Development and Approval Cycle

CHAPTER II: PROJECT DEVELOPMENT AND APPROVAL CYCLE

Project Development Cycle

Every project has certain phases in its development and implementation. These phases are useful in planning a project as they provide a framework for resource allocation, scheduling project milestones for implementation, and establishing a monitoring system. The purpose is to provide a basis for organizing the project for establishing resource requirements, and set up the management system that will finally guide the project activities. The phases of project development are commonly referred to as the project development cycle or project life cycle. The project life cycle phases may be broadly placed in the following categories:

(a) Concept or identification
(b) Definition or preparation
(c) Pre-feasibility
(d) Feasibility and financing
(e) Detailed design
(f) Implementation and monitoring
(g) Ex-post appraisal and impact evaluation

In the concept or identification phase, the public sector manager evaluates an idea. In the definition or preparation phase, it elaborates and refines the concept and does some initial work to define the components that make up the project. The pre-feasibility and feasibility phases comprise a more analytical exercise in which the viability of the project is examined from different points of view and the project is planned in detail. These two phases of the project cycle taken together mainly constitute the process of evaluation or appraisal of the project.

In the next phase of detailed design, the physical design of the project is completed and the plan for administration, operations, and marketing is finalized. The bulk of the actual work on the project is, of course, accomplished in the implementation phase. Finally, a critical evaluation of the project's outputs and outcomes is conducted in the last phase. As the project moves through its life cycle, the focus of managerial activities shifts from planning to operating and controlling the activities.

It should be emphasized that these phases only represent a natural order in which projects are planned and carried out and they are not sequential. Also, several of these phases do not become final until the project approaches its termination stage. The project development cycle is a continuous and dynamic process and there is a great deal of overlap, interaction and feedback among the various phases. Many of the activities are inter-related and cannot be confined to one particular phase.

Projects and State Development Plans

Projects provide a valuable tool for directing investments into the priority sectors of an economy. A state or regional plan lays down growth targets for various economic parameters like consumption, public and private sector investments and gross state product. This

exercise of macroeconomic planning is meaningful only when it is possible to make realistic assumptions about the level of investment that can be achieved in a certain period of time and its impact on the rate of growth. This presupposes knowledge of the existing and potential projects in the state sector and the pace at which they may be implemented.

It is also the main objective of the planning process to direct investment to those sectors where it will yield the maximum economic benefits to the state. Again, within a sector priority needs to be given to projects with the highest economic returns. It is possible to make this kind of judgment only with the help of economic analysis of projects. Thus the planning process is hardly relevant without project planning and without a rigorous analysis at the sector and project levels[1].

The reverse linkage between projects and plans is equally strong. For making a choice among projects, it would be necessary to estimate the market demand for the goods and services produced by those projects. Thus the microeconomic planning at the project and sectoral levels clearly depends upon how the overall economy is likely to develop in the course of time which, in turn, is a function of the long range plans and policies of the state government[2]. Thus the analysis of a project within the overall framework of a state plan should be more realistic as compared to a situation where no plan exists.

This clearly indicates a close interaction between project analysis and plan formulation[3]. A plan may be initially formulated without an adequate knowledge of the role of individual projects or sectors in the overall growth of the economy. This will sharpen the focus of the micro level planning. An improvement in the analysis of projects and sectors will help improve the quality of macroeconomic management. Thus there is a feedback process between project analysis at the micro level and planning at the macro level.

Concept or Identification Phase

This is the first phase of the project cycle and is concerned with the identification of potential projects. The purpose is to establish the basic desirability of a project and identify the high priority projects[4]. The type of projects that would qualify for being placed in this

[1] See Little, I. M. D. and J. A. Mirrlees; "Project Appraisal and planning for Developing Countries", Basic Books, Inc., New York (1974) for a discussion on the strong inter-linkage between plans and project choice.

[2] See Kaufmann, D. and Yan Wang, "Macroeconomic Policies and Project Performance in the Social Sectors: A Model of Human Capital Production and Evidence from LDCs," *World Bank* (1995).

[3] The integration between project planning and national or macro-level planning has been a significant issue in the literature on project analysis. At the micro level the individual projects have to be feasible while at the macro level a set of projects has to be selected that are collectively feasible and fit into a national perspective. See Noorbaksh (1993) for an excellent discussion of this issue.

[4] Baum, Warren C., "The World bank Project Cycle", in Finance and Development delineates and discusses the phases of the project cycle in the context of World Bank funding of public sector projects.

category will largely depend upon the level of development of the economy. States and regions differ with respect to their problems as well as their growth potential.

Action Points in Project Identification

The identification process implies undertaking of two sets of activities. First, the gaps in the economy should be identified and second, the sector priorities should be defined. These activities are truly dynamic in nature and keep evolving over time. Both these tasks are routinely performed during the planning process at the state, regional or district level. A thorough analysis of the gaps in development and the potential for growth is undertaken at the time of plan formulation and during periodical reviews. This also enables a continuous assessment of the progress and the shortfalls and provides valuable feedback to the policy makers.

The gaps in the economy could lie in one or more sectors such as basic infrastructure, food and agriculture, heavy or basic industry, or social sectors such as health and education. In practice, the identification of gaps is not a difficult task. What is difficult is the setting up of a clear priority among competing claims on the limited resources of the state or the region. This, in fact, constitutes the crux of the development problem and is the most difficult challenge that planners and policy makers face.

Problems in Project Identification

The following set of problems is often encountered in the process of project identification.

Resource surveys and project identification[5]: The lack of finances and scarcity of skilled manpower has acted as a major deterrent in carrying out detailed resource inventories that are needed for identifying projects and for rationalizing development plans. This is more so in agriculture, rural industries and natural resources sectors where detailed information can be obtained only after sustained research and survey work. There has been a tendency to move ahead with investments in certain sectors perceived as lead sectors, such as industries, rather than spending resources on research and surveys that would identify higher return areas that are perhaps not as obvious. For example, the rate of return on road repair and rehabilitation projects have tended to be much greater than the rate of return for new roads but the rehabilitation projects usually do not get due priority. The emphasis is mostly on initiating new projects.

Lack of skills to produce project alternatives: While capital scarcity is one of the main constraints, the problem of project scarcity is equally serious. Often, human resources do not exist in the state or the region for identifying suitable project interventions that are required to fulfill the plan objectives and

[5] Ward, William A., and Barry J. Derren, "The Economics of Project Analysis: A Practitioner's Guide", Economic Development Institute of the World Bank (1991) presents an excellent analysis of the various aspects of strategic planning and project appraisal.

achieve the development goals. Thus, there may be simply a lack of skills to produce project alternatives.

Sources of Project Identification

A project may be identified in a variety of ways.

(i) Conceived by existing departments or ministries in the government,
(ii) Emerge out of the process of formulation of plans at the national and provincial levels,
(iii) Identified by the people's representatives, and,
(iv) Proposed as a demand from interest groups or beneficiaries.

Preparation Phase

Once a project is identified, the process of preparation is initiated. This process involves the refinement of the elements described in the identification phase and includes all the steps that are necessary to bring the project to the stage of appraisal, which would consist of pre-feasibility and feasibility studies. While it is difficult to generalize about the preparation phase as it depends upon the nature of the project, preparation begins with the description of objectives, identification of the principal issues and setting up of a timetable for the different phases of development cycle. While many of these issues would have already been considered at the identification phase, all these aspects are addressed in greater detail during the preparation phase and concrete answers are sought to the various questions that arise in the context of the project.

It may be noted that the process of preparation must cover the full range of technical, institutional, financial and economic issues that are relevant to achieving the project's objectives. For instance, an irrigation project would require a study of several aspects such as the existing soil patterns and available water resources, appropriate cropping patterns for the area based on data available with the agriculture department, impact of the facility on a typical farm budget, extension services in public and private sectors, marketing infrastructure in the region, existing land tenure systems etc.

Policies and Procedures

Sometimes it may be necessary to examine the government policies and procedures that would have a major impact on the outcomes of the project. Also, sociological studies may be needed to ensure that the project fits into its physical and social environment so that its benefits are maximized. In the case of the irrigation project, for example, the government policies with respect to prices of inputs and agricultural products, the method for determination of user charges from the beneficiaries and the procedure for collecting these charges would have to be examined.

Technical and Institutional Alternatives

An important element of preparation is a critical assessment of the technical and institutional alternatives for the project. This is essential for the choice of an appropriate technical package necessary to implement the project and

identification of the agency or unit that would be responsible for project management. The choice of technology will largely depend upon the resource endowments of the national and local government and the stage of its development. For instance, most local governments suffer from a lack of capital but are abundant in labor. Thus some types of advanced technology may not be the most suitable for the specific state or region. The preparation phase requires an analysis of the benefits and costs of the technical and institutional alternatives followed by a more detailed investigation of the more promising alternatives. The process continues till the most satisfactory solution is arrived at.

It is evident that this process of project preparation is both time consuming and requires trained staff and financial resources. Each project means a long-term commitment of scarce resources and serious economic implications for the state. Therefore, the time and money spent in selecting the most suitable technical and organizational alternative is well spent because over the long term this effort will most likely be returned many times over by the enhanced return from the investment.

Pre-feasibility Phase

The preparation stage should be followed by the pre-feasibility phase. The pre-feasibility study is one of the two components of appraisal, the feasibility study being the other one. This is the first attempt to examine the overall potential or viability of the project. The data and information gathered at the preparation stage are used in this phase. It is a critical stage of the project cycle because it is the culmination of all the preparatory work and provides a comprehensive review of all aspects of the project before taking a final decision about its viability.

The pre-feasibility study is the stage for completing all the preliminary steps for going into a detailed feasibility exercise. Thus, it is the first part of conducting the appraisal of a project. Also, if a project does not prove to be promising at this stage, it may be rejected without investing any additional time and resources into its further examination and the process of appraisal is over for the project.

The pre-feasibility phase should normally comprise of the following modules[6]:

Marketing or Demand module

This module examines whether there is a demand for the goods/services of a project both in the domestic market, and the neighboring states. In many states, it is not unusual to come across defunct projects that were taken up because of political expediency or availability of funds from the central government for that type of projects but there was not sufficient demand for the good or service produced at that time to enable the project to become either financially or economically sustainable.

[6] See Jenkins, et al. (1998) for a discussion of the various aspects of project planning or the pre-feasibility phase.

The function of this module is not only to assess the current demand but also to undertake the more difficult task of forecasting the future demand. For the demand analysis of a product or service, it is necessary to conduct some primary research at the pre-feasibility stage by surveying the potential customers and users.

In the case of public sector monopolies, such as public utilities, government policies are an important factor in determining the demand for the output. Programs like electrification of rural areas and promotion of industrial complexes in urban areas will have an important bearing on the future demand for electricity. The growth in demand for the output of a public utility may be forecast fairly accurately by studying the relationship over time of demand with respect to variables such as population growth, disposable income, industrial output, and relative prices. The study of growth in demand experienced by utilities in other states can also provide a good indication of what to expect in the future.

Technical or Engineering Module

It looks at the input parameters of the project, quantities and prices of inputs by type required for construction of the project, inputs required for the operation of the project by year and volume of sales or service delivery, and the appropriateness of the technology adopted. It is also concerned with issues such as the size of the project, its design and location and the technology to be adopted including the equipment used and the processes employed. In a canal system for irrigation, for instance, this module will be concerned with the size and gradient of the main canals, the volume of expected water flow at the source, locations and numbers of secondaries, impact on the water table in the region and the availability of drainage facilities for excess water.

A major task in this phase is to conduct a close scrutiny of the cost estimates of construction along with the engineering data used to arrive at those estimates, provisions for contingencies and expected price increases during the implementation phase and cost estimates for operating the facilities. The procedures for procurement of materials and provision of professional services are also reviewed at this stage.

The output from the technical module of a pre-feasibility study should provide the following information:

Environmental Module

Several projects have a negative impact on the environment that may affect a group of people in the society adversely. This is an externality generated by the project and is not reflected in the private costs of the project. Industrial firms and infrastructure projects, such as power and transport, create different kinds of pollution that fall in this category. Some projects may deposit a lot of waste products or effluents in the atmosphere, waterways and the ground and these may have serious health implications. Again, the emissions from some projects have long-term impact on the global climate that may prove to be irreversible. All these have a damaging effect on people

and property that are not directly involved with the production or consumption of the output. The waste products emitted by one producer may adversely affect the production processes of other firms or well being of other consumers.

While this externality may not concern the private producer unless its cost is internalized through some mechanism of regulation, tax or subsidy, it certainly imposes a cost on the society and must be taken into account when the project is examined from the point of view of the economy. If this aspect of costs were ignored, investments that are not socially desirable would appear to be attractive and are likely to be included in the state's portfolio of development projects.

Whenever the project has an impact on the environment, all costs of pollution control equipment and facilities should be included in project cost. Whatever residual pollution and environmental impacts remain after the pollution control equipments are in place should be estimated and its economic value assessed. Finally, these values should be included as a cost in the economic cash flow of the project.

Manpower and Administrative Support Module

This module goes into the manpower requirements both for construction and operation phases of the project. It reconciles the technical and administrative requirements of the project with the supply constraint on manpower.

It is a mistake to confine project appraisal to the analysis of financial and economic costs and benefits under the assumption that the project can be built and ready for operations on time. This assumes a degree of administrative support for implementation of projects that in many states and regions does not exist. Many projects have failed because they were undertaken without the administrative expertise necessary to complete the project as specified. The prospect that future financial and economic benefits will materialize is only as good as the administrative capability of the agency in charge to put the project in place.

This module must reconcile the technical and administrative requirements of the project with the supply constraints on manpower. A careful study of the labor markets should be made in order to ensure that the estimates of wage rates to be paid are accurate and that the planned source of manpower is reasonable in the light of labor market conditions. In general, manpower requirements should be broken down by occupational and skill categories and these needs should be evaluated in terms of the possible sources from which they would be met.

Institutional Module

This module deals with the creation of a local institution responsible for managing the different stages or phases of the project. This local institution does not cover the borrowing entity and its organization alone, but it includes the entire management that goes into the project along with its policies and procedures. In a broad sense, the

institutional set up also incorporates the whole range of government policies and procedures. Experience shows that insufficient attention to the institutional aspects creates serious problems during the implementation and operations phases of the project.

Financial Module

This module provides the first integration of financial and technical variables estimated in the marketing, technical and manpower modules. A cash flow profile of the project is constructed, which identifies all the receipts and expenditures that are expected to occur during the lifetime of the project. An attempt should be made at this stage to provide a description of the financial flows of the project that identifies the key variables to be used as input data in the economic and social appraisal.

The financial appraisal also helps in determining the level and structure of prices or user fees to be charged from the beneficiaries in order to ensure the project's financial viability. If the facility is publicly owned and provides some basic service, this question becomes more important. Sometimes governments decide to subsidize specific services to consumers as a matter of policy or pure expediency. The recovery of user charges has to take into account the income level of the beneficiaries and the practical problems of administering a particular system. The degree of fiscal impact of such government policies on the budget has a strong bearing on the viability and sustainability of the project. In such cases, not only should the level and structure of prices be defined but also the procedure for making future adjustments in prices and government subsidy should be clearly laid down.

For instance, in an irrigation project the policy and procedure for recovering the investment and operating costs from farmers or water users is a matter of concern to the financing agencies including foreign donors and international agencies. Costs in this case may be recovered in a variety of ways: user charges from beneficiaries based on volume of use or area under irrigation, general taxation or requiring the farmers to sell all or part of their produce to a government marketing agency at a price controlled by the government. Each particular policy will have different implications for the level and efficiency of cost recovery and the ultimate financial viability of the project.

The financial module should answer a series of questions concerning the financial prospects and viability of the project.

i. What degrees of certainty do we place on each of the revenue and cost items in the financial analysis? What factors are expected to affect these variables?

ii. In case of public utilities or services provided by a public enterprise, what should be the level of user charges to ensure the project's financial viability and what would be the necessary

process and frequency of its revision?

iii. What sources of financing will be used to cover the cost of the project? Does this financing have special features, such as subsidized interest rates, grants, foreign equity or loans (tied or general)?

iv. Is there provision for adequate working capital in the project? Will internal revenues be enough for this purpose or will separate institutional funds be required?

v. What is the minimum net cash flow required by this investment to be able to continue operations without unplanned requests being made to the government treasury for supplementary financing?

vi. Does the project have a large enough net cash flow or financial rate of return for it to be financially viable? If not, what sources of additional funds are available and can be committed to the project if it is economically and socially justified but financially poor?

If any one of these questions points to future difficulties, then necessary adjustments should be made in either the design or the financing of the project to avoid problems in future that may adversely affect the project.

Economic Module

It examines the project from the entire economy's point of view to determine whether or not its implementation will improve the economic welfare of the country, the state or the region. An economic appraisal is of exactly the same nature as the financial analysis except that now the benefits and costs are measured from the point of view of the whole economic entity, which could be the country, the state or a specific region. Instead of relying on market prices to measure expenditures and costs as in the case of a financial appraisal, the economic analysis requires the use of techniques to determine the economic prices of goods and service, foreign exchange, cost of capital and labor. The true economic values of costs and benefits are not reflected in market prices in the presence of various distortions such as trade restrictions, price control, taxes, subsidies, and minimum wages.

Some of the elements of project costs and benefits such as environmental pollution, better health and education facilities, manpower training may not be easy to quantify. The best approach in such cases would be to find people's willingness to pay for the service or their willingness to pay for avoiding a negative outcome. The willingness to pay also provides a valuable benchmark for determining the financial level of user charges for services. The financial charges may be raised to the level of the economic prices because the latter indicate the benefit that people derive from the good or service in question and

their willingness to pay for the same. It is, however, not always easy to get a measure of the willingness to pay. In some cases, it may be possible to have proxies that help measure people's willingness to pay and thereby estimate the value of a service to the economy.

The questions covering the economic appraisal of a project are as follows.

i. What are the magnitudes of the differences between the financial and economic values of variables that are affected by government regulation and control or are subject to taxes, tariffs, and subsidies?

ii. What are the magnitudes of the differences between the financial and economic values of variables that are affected by other imperfections in the factor and product markets (e.g., labor unions and restrictive trade practices)?

iii. When evaluated at a discount rate that reflects the relevant cost of capital to the economy as a whole, does this project produce a positive net present value?

Social Appraisal or Distributive and Basic Needs Analysis

This deals with the identification and quantification, whenever possible, of the impacts on the various stakeholders of the project. These include impact on the well being of particular groups in society. While this aspect of the appraisal may be less precise than the financial or economic analyses of a project, the social evaluation will generally be tied to the same factors that make up the financial and economic appraisals. For example, a project cannot be expected to assist consumers unless it increases the supply of a good or service at a price not greater than its previous price.

The social appraisal of a project may be organized into two parts; first, estimating how income changes caused by the project are distributed among the various stakeholders to the project (distributional analysis) and second, identifying the impact of the project on the basic needs in society (basic needs analysis). In conducting a distributive analysis, the net impact of all externalities, which is the difference between the real economic values of resource flows and their real financial values, are measured for each market in present value terms and allocated across various stakeholders of the project. Finally, additional net benefits are attributed to the project if it provides for one or more of the basic needs. For instance, a road project in a rural area not only reduces transportation costs but it may also allow the children to attend school and the sick to get better health care. Both these aspects are viewed positively by society and a social net benefit should be attributed to the project to account for this externality.

Nature of Distributive Analysis

In essence, a distributional analysis combines the financial analysis for each

group with its corresponding externalities. The sum of the financial outcome and the externalities generated across the various groups should add up to the economic analysis of the overall project. In this way, it is possible to identify those groups that gain and those that lose and the extent of gain and loss as a result of a project. It provides a very valuable input to the policy makers.

Nature of Basic Needs Analysis

The basic needs externality can be thought of as the price that society is willing to pay for any increases in the recipients' consumption of particular goods or services that contribute to the fulfillment of basic needs. The willingness to pay for basic needs can be added vertically to the private demand curve of the target group to create a social demand curve.

An illustrative set of questions to be asked while undertaking a social appraisal of a project is as follows.

i. What social objective could the project assist in attaining?

ii. Who are the beneficiaries of the project and who is expected to bear the costs?

iii. In what alternative ways and at what costs could the government obtain social results similar to those expected from this project?

iv. What are the (net) economic costs of undertaking these alternative projects or programs and is the project relatively cost effective in generation of desirable social impacts?

v. What are the basic needs of the society that are relevant in the country and what impact will the project have on basic needs.

Use of Secondary Data in the Pre-feasibility Phase

Whenever possible, the pre-feasibility study should utilize secondary research data. Most technical and marketing problems have been faced and solved before by others; therefore, a great deal of information can be obtained quickly and cheaply if the existing sources are utilized efficiently. Secondary research is probably most useful in the technical and engineering modules but less valuable in the marketing and the manpower and administrative support modules. Marketing and administrative support modules generally require information that is specific to the project and may require some primary data.

Engineering firms and technical experts in the field usually have considerable experience in other projects that have used either identical or similar technology. Often there are a number of consulting firms or government agencies that have technical expertise in a specific area. Utilization of the published research materials on commodities and technical aspects of projects from international organizations and institutions or associations disseminating pertinent information is essential.

Feasibility Study and Financing Negotiations

After completing all the modules of the pre-feasibility phase, the project must be examined to see if it shows promise of meeting the financial, economic, and social criteria that the government has set for investment expenditures. It is at the end of this stage that the most important decision has to be made as to whether the project should be approved. It is much more difficult to stop a bad project after the detailed and, often, expensive design work has been carried out at the next stage of project development. Once sizable resources have been committed to prepare the detailed technical and financial design of a project, it takes very courageous public servants and politicians to admit that it was a bad idea.

If the outcome of the feasibility study is such that the decision-makers give their approval to the project, then the next major steps are tying up the financing and developing the detailed project design. Negotiations about the financing of the project have to be finalized with all the financial institutions and a detailed loan document drawn. The drafting and negotiation of the legal documents are essential for ensuring that the borrower and the lenders are in agreement not only on the terms of financing but also on the broad objectives of the project and the detailed schedule and specific activities necessary for implementing it.

Detailed Design

Preliminary design criteria must be established when the project is identified and appraised but usually expenditures on detailed technical specifications are not warranted at that time. Once it has been determined that the project will continue, the design task should be completed in more detail. It involves detailing the basic programs, allocating tasks, determining resources and setting down in operational form the functions to be carried out along with their priorities. Technical requirements, such as manpower needs by skill class should be finalized at this stage. Upon completion of the blueprints and specifications for construction of facilities and equipment, operating plans and schedules along with contingency plans must be prepared and brought together before going into the implementation phase.

When this process is completed, the project is again reviewed to see whether it still meets the criteria for approval and implementation. If it does not, then this result must be passed on to the appropriate authorities for final disapproval or rejection of the project.

Project Implementation

If the appraisal and design have been properly executed and negotiations to finalize the conditions for financing successfully completed, the formal approval of the project is sought from the competent authority. The formal approval will require the acceptance of funding proposals and agreement on contract documents, including tenders and other contracts requiring the commitment of resources.

The next stage in the project's life cycle is its actual implementation. This is, evidently, the most important part of the project cycle. The project implementation phase covers both the completion of construction activities and the subsequent operations and is generally divided into three different time periods. First is the investment period when the major project investments take place. Second is the development period when the production capacity gradually builds up. The final phase is that of full operations. Implementation is a dynamic process in which every one involved with the project has to constantly respond to new problems or changing circumstances that may affect the project's outcome.

The process of implementation involves the coordination and allocation of resources to make the project operational. The project manager has to bring together a project team including professionals and technicians. This team will, in turn, have to coordinate with the various consultants, contractors, suppliers and other interested agencies involved in putting the project in place.

Responsibility and authority for executing the project must be clearly assigned. This will include the granting of authority to make decisions in areas related to personnel, legal and financial matters, organization and administration. Proper planning at this stage is essential to ensure that undue delays do not occur and that proper administrative procedures are designed for the smooth coordination of the activities required for the implementation of the project.

A system of monitoring and supervision has to be evolved for completing this phase successfully and on time. This task is very important because all projects face some implementation problems. The problems may arise either because of some flaw or shortcoming in the planning of the project or simply because of changes in the economic and political environment. The monitoring takes place at various levels. The first and the foremost level is the monitoring by the project manager and his team. This is done almost on a daily basis. Again, there is periodic monitoring by the higher management levels in the department or the implementing agency and also by the concerned ministries in the government. Different sets of criteria have to be evolved for monitoring by the different levels of supervisors within the organization and outside.

Ex-post Appraisal and Evaluation

Historically, considerably more resources have been spent on the pre-evaluation of projects than on the review of the projects actually implemented. For the development of the operational techniques of project appraisal and the improvements in the accuracy of evaluations, it is very useful to compare the predicted performance with the actual performance of projects. In order that this review of the strengths and weaknesses of implemented projects be of maximum value to both policy makers and project analysts, it is important that some degree of continuity of personnel be maintained within the project evaluation teams through time.

In carrying out ex-post appraisal, both elements of success and failure are systematically analyzed. It need not be conducted only for completed projects, but may take place at various stages during the project's implementation and operational phase. A careful appraisal of a project is a must before planning any follow up projects. A final detailed ex-post appraisal should, of course, be undertaken after the project is terminated.

To facilitate this type of appraisal, a review of the administrative aspects of the project development should be made immediately after the project becomes operational. The managers of the operational phase of the project should be made aware of the fact that an in depth appraisal of the project's performance is to be carried out. This ensures the development of necessary data from an early stage and makes the appraisal process quite cost effective.

The scope of ex-post appraisal is much wider than an audit. The audit has an important function and it should be conducted immediately after the construction phase is over and a completion report is submitted. The project's outcome (net present value or internal rate of return) should be re-estimated on the basis of the actual investment costs and the updated costs of maintenance and operations. This, however, is not sufficient to enable the project management, the government department or the parent agency to draw meaningful lessons for design and preparation of future projects.

The function of the post appraisal is not only to assess the performance of a project and give an ultimate verdict as to its overall contribution to the state's development, but also to identify the critical variables in the design and implementation of a project that determined its success or failure. It is expected that well considered recommendations would emerge from the appraisal about improving each aspect of the project design and its actual implementation. Based on such appraisal, ongoing projects may be modified and subsequent projects in the sector can be improved from the experience of completed projects. Also, new policies, better management practices and improved procedures can be adopted to improve project performance in general.

Ex-post appraisal may be done by different people who are directly or indirectly involved with the project. The project management, the sponsoring government department or agency, the operating ministry, the planning organization in the government or an external aid agency may be interested in the process. Each of these agents has its own lessons to draw from different aspects of the project.

Finally, the evaluation of a project involves an assessment of the outcomes of a project or its impact on the beneficiaries rather than simply the measurement of the outputs of the project. For instance, while the appraisal of an irrigation project would involve an analysis of costs and benefits to the various stakeholders who are involved in constructing the irrigation system, the

evaluation would imply the study of change in agriculture productivity in the region. Similarly, the evaluation of a school may involve an estimation of its impact on literacy in the region rather than simply looking at the number of school going children. Thus the project evaluation would often include pre- and post- project benchmark surveys to see how the project has been able to achieve its overall objectives.

Chapter III: Project Evaluation Framework

CHAPTER III: PROJECT EVALUATION FRAMEWORK

Integrated Project Analysis

Traditional approaches to the appraisal of investment projects have tended to undertake the economic analysis in isolation from the financial analysis, thus ignoring the interaction of the financial and economic outcomes. It is quite common to find that the impact of possible changes in the economic policy environment has not been factored into the design of the project and the assessment of its risk. Consequently, analysts have generally failed to identify and make provisions for policy and institutional variables that are important determinants of the sustainability of many of these investments. The economic distortions that financially subsidize a project, when removed, often become a major source of failure for these investments. Reduction in the level of trade protection is a well-known example of this problem.

The Integrated Project Analysis adopted in this manual expands the scope of the analyses of both public and private sector projects beyond the traditional practice of decision making on the basis of the financial and economic net present values of an investment. It demonstrates that if the economic and financial analyses are carried out using a common *numeraire*, preferably expressing all values in terms of the domestic prices at the domestic price level, the scope of the analysis can be expanded to include issues of stakeholder impacts, poverty impacts, and an assessment of the long-term sustainability of the project. Instead of just providing summary statistics of the financial and economic net present values for the project, we are now able to assess the income impacts that the project will have on different interest groups in society.

An important contribution of this analysis is that it forces the analyst to do a reconciliation of the economic performance, the financial performance and the distributional impacts of a project. If the economic and financial analyses of a project have been done consistently, the distributional stakeholder analysis is a relatively straightforward outcome. The benefit of such an extension of the analysis is very important for assessing the political-economic dimensions of public sector investments. The need for identifying the project's stakeholders, the groups who will benefit from the project and those who will lose, is crucial. A project's likelihood of successful implementation or long term sustainability is likely to be threatened if specific groups in society are unwittingly hurt by it. *In many cases, the most important factor determining a project's sustainability is its impact on the government budget.* For sustainability, the project's fiscal impact must be consistent with the ability of the public sector to finance such activities.

To undertake an integrated financial, economic and distributive investment appraisal or to evaluate the sustainability of a project, two steps need to be taken:

(a) First, the project's financial profile should be compared on a period-by-period basis and not just summarized in single statistics such as the NPV or the internal rate of return (IRR). Such summary criteria examined in isolation do not accurately assess the sustainability of a project or its riskiness. Consider a project that has both a large financial internal rate of return (FIRR) and a large positive NPV, but also has negative financial cash flows in the early years of its life. Such a project may go bankrupt, jeopardizing its economic performance, long before it has a chance to generate the large positive net cash flows expected in later years. It is the examination of the cash flows year by year over the project's lifetime that will give the analyst an indication of the sustainability and financial riskiness of the project. If a project is not financially feasible on its own, then a realistic assessment of the degree of budgetary support that it is likely to receive from the government needs to be made.

(b) Second, the financial and economic analyses must be expressed in the same unit of account. If we do not use the same *numeraire* we cannot successfully investigate the differences between financial and economic values of inputs and outputs. If the units of account are different for financial analysis and economic analysis, then the differences between the economic and financial values have no significance or meaning. In the literature on benefit-cost analysis, the three common choices for the *numeraire* are: domestic currency at domestic price level, domestic currency at the border price level, and foreign currency at the border price level.

Financial analysis is usually performed in domestic prices at the domestic price level because these are the currency and the price levels in which the markets of the country operate. Therefore, the use of any other *numeraire* quickly diminishes the level of understanding that decision-makers will derive from the analysis. Analysts, who want to take an integrated approach in examining the risk, sustainability and distributional impacts of a project, usually find it much easier to work with domestic prices at the domestic price level so that the economic analysis and financial analysis of a project can be readily compared. This is the *numeraire* used in this manual and thus the entire analysis is in domestic prices.

Financial Analysis

The cash flows that are available to both equity owners and debt-holders are the expected incremental net cash flows to *total* capital. A project likely to be attractive to all investors only if the NPV of the incremental net cash flows to total capital is positive.

If the company proposing a project appears to be stable, but the project does not yield the private investors a sufficient (or required) rate of return, then a related function of the financial analysis is to measure the minimum amount of incentive or assistance that would be needed to induce the private

investors to undertake the investment (i.e., the amount needed to bring the NPV from a negative amount to zero). This is the reason why the financial analysis is one of the cornerstones of the methodology for determining the amount of budgetary support needed for a public sector project or the government financial assistance or contractual, partnership or regulatory arrangement required for the private sector to undertake the investment.

Generally, in the financial analysis there are two perspectives on the financial flows. The first is the so-called free cash flows to the total investment. It is out of these cash flows that the different financiers will have to recover their investments. Debt holders in particular are interested in whether the free cash flows offer them a sufficient margin of safety to cover the debt repayment schedules.

Table 3.1. Key characteristics of financial analysis of self-financing and non-self-financing projects

	Self-financing investment projects	**Non-self financing projects**
Source of payment of operational expenses and financing costs	Sales revenue has to cover all costs	Exogenous finances such as government tax revenues have to cover any balance of operational expenses and financing costs
Key forecasts to assure project finances	Market demand and sales revenues	Tax revenue forecast
Key source of economic benefits	Market demand	User benefits (with or without user charges)
Typical projects	1. Private sector projects 2. User-financed public projects 3. Public Private Partnerships	Public sector projects (with no or low user charges) such as public infrastructure or social services
Key financial analysis questions	1. Is investment financially attractive to equity holders? 2. Are the free cash flows from the total investment sufficient to cover the debt repayment at an acceptable level of default risk?	1. Can adequate debt and revenue financing be raised to cover capital investment expenditures? 2. Will sufficient revenues be available over the future years to cover operational costs and debt repayments?
Derivation of economic benefits of project	Economic benefits are found directly from private market demand	Separate analysis required of the net benefits derived by users of public project – for example farmers gains from irrigation or rural roads

The other perspective is that of the equity holder or project sponsor who receives the residual cash flows after the debt holders have been repaid. These net cash flows have to be sufficient to recover the equity holder's capital

investment. This perspective is critical in all private sector projects as well as all public projects that expect to cover their costs through user charges or for all public private partnership arrangements.

In all other non-self-financing projects with little or no user charges being collected, the financial viability of the project depends upon the estimation of future availability of general public sector revenues. Table 3.1 is provided to help sensitise the project analyst to the different roles of financial analysis for self-financing and non self-financing projects.

The building blocks for the financial analysis of a project are as follows:

Investment Plan

- Combines information from the *market* and *technical* ***analyses*** to establish a detailed plan for annual incremental expected capital expenditures during a project's investment phase. Capital expenditures include expenditures on land, buildings, machinery, equipment, building materials, and construction and management labor.
- Should provide estimates of the liquidation or scrap value of all major fixed assets and the value of net working capital at the end of a project's life.
- Should disaggregate expenditures on machinery, equipment, and building materials into tradable and non-tradable commodities.
- Should indicate the breakdown of workers by skill and likely sources of availability.

Operating Plan

- Combines information from the market and technical analyses to establish a detailed plan for the operating phase of a project.
- Should provide projections of expected sales revenues and expected operating costs for each year during the operating phase. Operating costs include operating material inputs and operating labor.
- Should forecast annual net working capital requirements.
- Should also specify the management and operating manpower requirements by skill and source of availability for each year of the operating phase.
- Should disaggregate material inputs into tradable and non-tradable commodities.

Financing Plan

- Should provide details about how any anticipated negative net cash flows will be financed during both the investment and operating phases of a project.
- Equity investors should be identified and the anticipated timing of their contributions should be specified; dividend policy, if any, should also be stated.
- Debt-holders should be identified and the anticipated timing of their contributions should be specified; interest and amortization schedules should also be stated.

These financial data can be combined in the manner described to determine whether a project is financially viable and attractive to investors.

Financial Attractiveness

There are various criteria that can be used to judge the financial attractiveness

of an investment opportunity. These include the net present value (NPV) criterion, the internal rate of return (IRR) criterion, the payback period, and benefit-cost ratios. The strengths and weaknesses of these criteria are reviewed below.

Economic Analysis

The starting-point for the economic analysis is the expected incremental net cash flows to total capital from the financial analysis. When there are perfectly competitive, undistorted markets (for closely related commodities), and there are no other reasons for economic externalities to exist, market prices will provide a reasonable measure of marginal economic benefits or marginal economic costs. Under these conditions, and where a project introduces only small changes in the demand for its inputs and in the supply of its outputs, the financial analysis could serve as a proxy for the economic analysis.

When these requirements are not satisfied, however, then market prices no longer provide a reliable measure of marginal economic benefits or costs. The broader perspective taken by the economic analysis requires that a series of adjustments be made to convert estimates of incremental cash receipts into incremental economic benefits and estimates of incremental cash disbursements into incremental economic costs. These adjustments are based on Harberger's three basic postulates for applied welfare economics, which can be used to measure economic benefits and costs and then to add them up, summarized in three principles: willingness to pay represents the project's benefits, supply price measures the cost of production, and "an Iraqi dinar is an Iraqi dinar no matter who receives it or who pays it."

The market distortions referred to above fall into the broad category of externalities. In a nutshell, these distortions or externalities comprise of taxes, subsidies, trade tariffs, price controls, monopoly markets, environmental impacts such as pollution or congestion, and open access or common property situations. Again, we come across these externalities in estimating the price of capital (discount rate) because of imperfect capital markets and the price of foreign exchange because of trade distortions and controls in the foreign exchange markets. Similarly, there may be distortions in the labor market where the financial wage rate may be different from the economic price of labor because of taxes, minimum wage rules and other imperfections in the labor market.

In the case of private sector projects or other self-sustaining projects such as public sector investments expecting to recover their costs from user charges (such as is the case with public private partnerships), the economic benefits can be found from the market demand for the project outputs adjusting for the externalities in this and related markets. By contrast, for non-self-sustaining projects such as a public road, the economic benefits are all external to the project financial accounts. Essentially in such cases a separate financial and

economic analysis is required of the benefit derived by the user. This is commonly done, for example, to estimate the benefits that farmers may derive from a new irrigation scheme or new rural road. This difference is noted in Table 3.1 above.

The impact of a project on other industries or sectors is also of importance to its economic analysis since industries producing close complementary or substitute products may experience demand or supply changes as a result of a project. In particular, industries producing close complements to a project's output are likely to experience an increase in demand whereas those producing close substitutes are likely to experience a decrease in demand. If the markets for these products are also distorted due to congestion, pollution, taxes, or subsidies etc., then additional economic externalities will arise. Also, the cost of producing these related products could be affected if a project introduces a technological innovation that lowers costs (a technological externality). These externalities should be incorporated into the economic analysis of a project.

The economic analysis is a key determinant of whether a project should receive government financial assistance. Only a project with a positive NPV of incremental net economic benefits should qualify for approval and/or financial assistance.

Distributional Analysis

The distributional analysis, also referred to as stakeholders' analysis, deals with income changes that are brought about as a result of the project. This part of the analysis asks the following question: who will benefit from the project and by how much and who will lose or will pay for the project and by how much? Both the financial and economic analyses have to be completed before the distributional impacts can be determined.

This Manual does not attempt to attach different values to the benefits received by different income groups. Instead, the procedure adopted is based on Harberger's third basic postulate that treats a dinar as a dinar no matter to whom it accrues, and therefore, adds up the costs and benefits without regard to which person receive them.

The use of distributional weights could lead to misleading conclusions and possibly an artificial re-structuring of the project. Assigning weights for various subgroups in the economy could mean that the attractiveness of the project is dependent on how it is financed. This would necessitate not only the analysis of the project's incremental benefits and costs but also of the various tax increases which could be used to finance it. Clearly, this would complicate the evaluation of the project.

A distributional analysis combines a financial analysis along with the corresponding externalities affecting each group. The sum of these analyses across the various income groups should add up to the economic analysis of the overall project. In this way, it is possible to identify those groups that gain and those that lose as a result of a project.

Risk Analysis

Like everyone else, project analysts simply do not know with certainty what will happen in the future. Hence, the forecasts that are used in the market, technical, financial, economic and distributional analyses are all made under conditions of uncertainty. The prices of inputs and outputs, wages, rate of inflation, and exchange rate are all crucial for projecting future cash flows and it is not known how their values will vary over the life of the project. As such, the single valued outcome (NPV, IRR) of the financial analysis will not be accurate or meaningful. As the economic and distributive analyses are based on the financial cash flows, their outcomes will also suffer from the same shortcoming. It is no exaggeration to say that the only thing known with certainty about the outcome of project analysis is that the numbers emerging from it will never be attained when the project is actually implemented.

Since many of the parameters are uncertain, the results of financial, economic and distributional analyses in terms of the selection criterion (IRR or NPV), the cash flows and the externalities will yield only one of the several probable values. What is required is a distribution of values of these outcomes that incorporate all the possible values that the various parameters may assume. When there is no information about likely probability distributions of prices and quantities, it is necessary to make informed guesses about future values of a project's variables. In other cases when some knowledge of probability distributions is available, it will be possible to calculate the *expected values* of the variables, or to make projections based on past data that take account of the historical means and variances of the variables. The topic of risk analysis provides the methodology for dealing with uncertainty when there is some knowledge of probability distributions.

To begin with, a sensitivity analysis tells us which parameters are significant for the outcome of the project. These become risk variables. Other parameters that do not matter much may be ignored. For each risk variable, a probability distribution and range of values is assigned. Correlations among variables are also built into the model. Finally, a Monte Carlo simulation is performed and the model results are analyzed. What the risk analysis yields is not a single number but a distribution of results, such as expected values of the desired outcomes, the probabilities of negative returns and the variability of outcomes. Risk analysis is then extended to economic and distributive analyses. The results of the risk analysis enable the decision makers to make a more informed decision about project selection.

To manage risk a way must be found to redesign or reorganize a project in order to reallocate risk efficiently. This requires not simply a cost perspective, where the aim is to reduce risk to one party by shifting it on to others - clearly a zero-sum game - but rather an efficiency perspective, where with the right contracts one party can gain substantially without corresponding

costs to other parties. The solution is to reallocate risk to those parties who can best bear it.

Chapter IV: Schematic Diagram

CHAPTER IV: PROJECT EVALUATION DIAGRAM

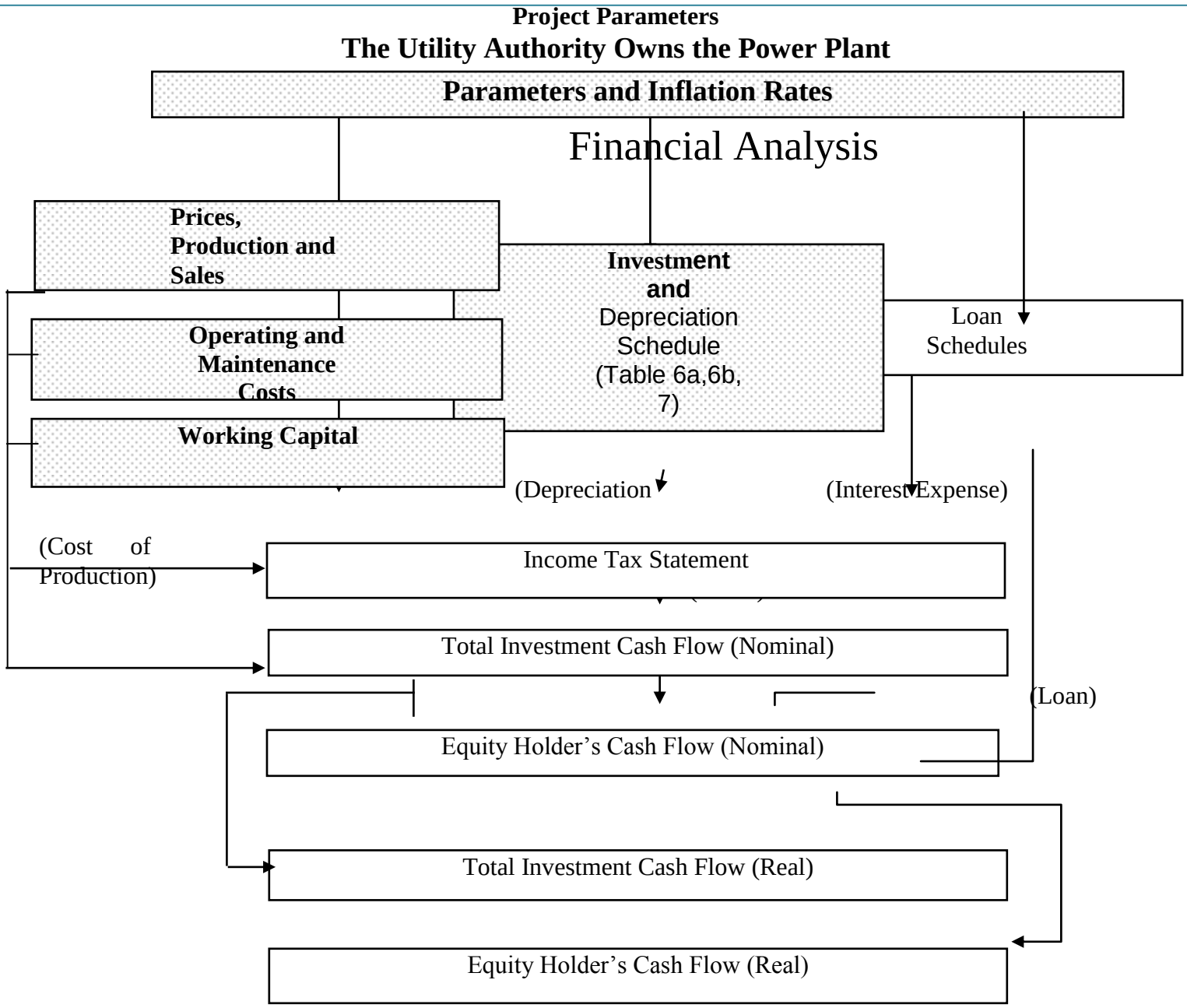
This schematic diagram of project evaluation framework is based on a hypothetical power project.

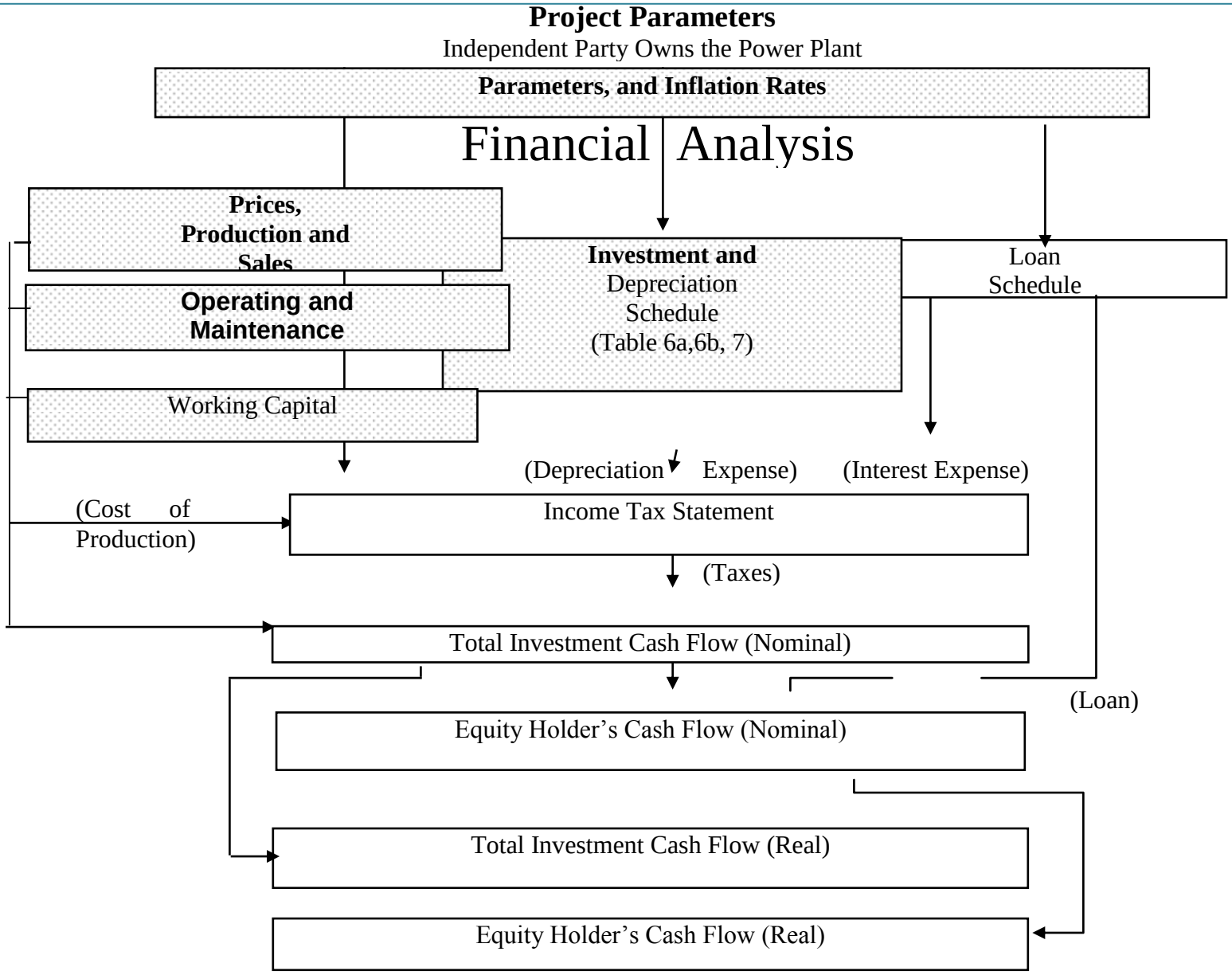
Basic Facts:

- The utility authority of the county currently operates two dams, and a thermal power plant (installed capacity of 912, 160 and 30 MW, respectively).
- The utility authority proposes to build a third dam to meet the increasing domestic and foreign demand of electricity on the system. The dam will be located about 150 km north of a lake.
- The expected annual amount of electricity generated is 1150 GWH. Part of the energy generated will be exported to the neighboring countries.
- The total project cost (at 1996 price level) is estimated at 310 million US$. 79% and 21% of the total cost are in foreign and domestic currency, respectively.
- Foreign component of investment cost is financed with a subsidized foreign loan.
- Tariff rates charged to main domestic and foreign clients have remained unchanged for years. Under a contractual arrangement with foreign clients, tariff rates are adjusted for inflation every five years.

Project outcomes:

- Under the current tariff policy, the project is not viable from the financial viewpoint. The net present values are -44 and -174 billion in domestic currency when the utility or an independent power project undertakes the project respectively.
- Different tariff rates, which take into account the construction cost of the hydro plant makes the project financially viable from the equity holder's point of view. It is recommended to negotiate a faster adjustment of nominal tariffs with domestic customers.
- Project is highly attractive from the economic point of view (NPV equals to 72 billion of domestic currency), with a 10% probability of negative economic outcome.





Economic Analysis

Step One:

National Economic Parameters:

a. Economic Opportunity Cost of Capital
and Foreign Exchange Premium

+

Step Two:

Economic Conversion Factors for:

b. Basic Conversion Factors
c. Project Inputs, including
- Investments
- Operating Expenses
- Labor
- Working Capital

d. Economic Value of Power

(Applied to Real Financial Cash Flow Statement)

Statement of Economic Costs and Benefits

Distributive Analysis

The Utility Authority Owns the Power Plant

A. Economic Real Net Resource Flow

- (Minus)

B. Financial Real Net Resource Flow

(Yields)

C. Net Resource Flow of Externalities	**D**. Present Value	**E**. Allocation of Externalities

Distributive Analysis

The Utility Authority Owns the Power Plant

F. Summary of Distribution Project's Net Benefits

G. Reconciliation of Economic and Financial:

Economic NPV = Financial NPV + PV Externalities

Distribution Analysis

Independent Party Owns the Power Plant

A. Net Resource Flow of Externalities

+ (Plus)

B. Additional Real Opportunity Cost

- Power Price - Current Tariff
- Net Cash Transfer from the utility authority to independent power project

(Yields)

C. Net Resource Flow of ExternalitieS

D. Present Value

E. Allocation of Externalities

F. Summary of Distribution of Net Benefits

Distribution Analysis

Independent Party Owns the Power Plant

A. Net Resource Flow of Externalities (Authority Owns Project)

\+ **(Plus)**

B. Additional Real Opportunity Cost to Pay for Thermal

- Power Price from IPP- Current Tariff
- Net Cash Transfer from VRA to IPP

⇩ **(Yields)**

C. Net Resource Flow of Externalities

D. Present Value

E. Allocation of Externalities ⇩

F. Summary of Distribution of Net Benefits

Risk Analysis

A. Sensitivity Analysis

B. Risk Variables

C. Results

Chapter V: Project Evaluation Criteria

CHAPTER V: PROJECT EVALUATION CRITERIA

Introduction

As mentioned in the previous chapter, the financial attractiveness of a project is determined by the net present value (NPV) of its expected incremental net cash flows and the economic desirability is measured by the NPV of its incremental net economic benefits. The NPV criterion is widely accepted by accountants, financial analysts, and economists as the only criterion that yields correct project choice in all circumstances. However, some private investors and public sector agencies have frequently relied upon other criteria such as a project's internal rate of return (IRR) or a benefit-cost ratio; some have used a payback period criterion. The strengths and weaknesses of these criteria are examined in this chapter in order to demonstrate why the NPV criterion is the most reliable one for government analysts to use.

Time Dimension of a Project

Investment decisions are fundamentally different from consumption decisions because the former have a time dimension. For example, land and capital equipment are purchased at one point in time, and they are expected to generate net cash flows, or net economic benefits, over a number of subsequent years. To determine whether the investment is worthwhile it is necessary to compare the benefits and costs that occur in different time periods. The problem is that a Iraqi dinar spent/received today is worth more than an Iraqi dinar spent/received in a later time period. In other words, it is not possible just to add up the benefits and costs of a project to determine which is larger without first taking account of the fact that dinars spent on investment today are worth more today than the dinars received in benefits in the future.

Expressing the values in terms of either future or present values can capture the time dimension of a project's net cash flows and net economic benefits. When moving forward in time to compute future values, analysts must allow for the *compounding* of cash flows. When bringing future values back to the present for comparison purposes, it is necessary to *discount* them. Discounting is just the inverse of compounding.

Time Value of Money

Time enhances the value of a dinar today and reduces the value of a dinar spent/received in the future. Because individuals consider waiting before incurring a cost, it is necessary to compensate them for forgoing their consumption today and instead lending their funds to a bank or a borrower. Thus, banks and other financial institutions have to offer interest payments to the lenders to induce them to part temporarily with their funds. If the annual market interest rate were 5%, then 1 dinar today would be worth 1.05 dinars in a year's time. This implies that in equilibrium, lenders value 1.05 dinars in a year's time the same as 1 dinar today.

Compounding

There are two main ways that interest can be included in future values, simple interest and compound interest. Simple interest is paid on only the principal amount that is invested while compound interest is paid on both the principal and the interest as it accumulates. Over time, compound interest, which is the most commonly used way of charging interest, can cause the future value of 100 dinars invested today to increase by substantially more than simple interest. The difference is due to the interest on the cumulative interest. The formula for compound interest payment is:

$$V_t = V_0 \times (1+r)^t,$$

where V_t = value in year t, V_0 = value in year 0, r = the interest rate and t = time period.

The interest may be compounded annually. It is not, however, uncommon for interest to be compounded more frequently, e.g., semi-annually, quarterly, monthly or even continuously. The number of compounding intervals also affects the future value of an amount of cash invested today. The other two factors that affect the future value of dinars 100 invested today are the time period of investment and the interest rate.

When comparing two debt contracts, furthermore, it is essential that they be judged on the basis of equivalent rates - annual rates in the case of most loan agreements, semi-annual rates in the case of bonds. The magnitude of the interest rate is certainly a major determinant of future value.

The formula for determining the future value using a constant interest rate is

$$FV = 100*(1 + r)^t$$

However, if interest rates were expected to vary over time, then the formula would become

$$FV = 100*(1 + r_1)(1 + r_2)(1 + r_3) \ldots (1 + r_t),$$

where r_i = the expected interest rate in year i.

If interest rates are expected to increase over time, and if this expectation could be captured in a loan agreement, then its future value would be higher than with a constant rate.

Discounting

The discount factor allows us to compute the present value of a dinar received/paid in the future. Since we are moving backward, rather than forward in time, the discount factor is the inverse of the compound interest factor. At a 10% annual discount rate the discount factors are as follows:

Years	**0**	**1**	**2**	…….	**50**
Discount Factor	**$1/(1.1)^0$ = 1.0**	**$1/(1.1)^1$ = 0.909**	**$1/(1.1)^2$ = 0.826**		**$1/(1.1)^{50}$ = .0085**

The later a cash flow is received or paid, the lower its present value. Thus, 100 dinars received 50 years from now has a value of only dinars 0.85 today at a discount rate of 10%.

The magnitude of the discount factor is affected by the same variables as those that determine the magnitude of the compound interest factors. One is the compounding interval.

The annual discount factor is $V_0 = V_t/(1+r)^t = V_t(1 + r)^{-t}$.

The continuous discount factor is

$V_0 = V_t/e^{rt} = V_t(e^{-rt})$, which is a

smaller number.

Besides the timing of the cash flow, the other factor that determines the discount rate is the level of market interest rates. This is why it is critical to pay careful attention to the estimation of the private and economic discount rates in the financial and economic analyses.

The present value can also be interpreted as the amount that would have to be set aside today in order to have $100 at a future date. This is evident from taking the future value of the present value.

The Net Present Value (NPV) Criterion

The net present value (NPV) is the algebraic sum of the present values of the expected incremental positive and negative net cash flows over a project's anticipated lifetime. If this sum is equal to zero, then investors can expect to recover their incremental investment and earn a rate of return on their capital equal to the private discount rate used to compute the present values.[7] However, if the private discount rate is based on the market cost of capital for a project of equivalent risk, as it should be, then investors would be no further ahead with a zero-NPV project than they would have been if they had left the funds in the capital market. Investors are not worse off; they are just not better off.

A NPV greater than zero means that investors can expect not only to recover their capital investment and earn a rate of return equal to the discount rate, but also to receive an addition to their real net worth equal to the positive amount of the NPV. In other words, a positive-NPV project outperforms the capital market and makes investors better off.

Finally, if the NPV is less than zero, then investors cannot expect to earn a rate of return equal to the discount rate, nor possibly to recover their invested capital, and hence, their real net worth is expected to decrease**.** Only projects with positive NPVs are going to be beneficial and hence attractive to private investors. They are unlikely to pursue a project with a negative NPV unless there are strategic reasons or they receive financial assistance.

[7] The recovery of the invested capital is anticipated when $NPV \geq 0$ because the incremental capital expenditures are included in the initial negative net cash flows.

The formula for computing the NPV of expected incremental net cash flows over n time periods with annual discounting is:

$$NPV = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$$

where the incremental net cash flows (C_i) could be negative, zero, or positive, and r is the discount rate equal to the cost of capital and the sigma sign ($\sum$) is the symbol for summation. It is today's cost of capital that matters because that is what it either costs to raise the funds or is being forgone as a result of using available funds for a project rather than putting them to work in the capital market.

The NPV formula for the annual net cash flow can be written out in its component present values as follows:

$$NPV = C_O + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_n}{(1+r)^n}$$

The net present value criterion can be stated in the form of a set of decision rules.

Decision Rule 1: Do not accept any project unless it generates a positive NPV when discounted by a discount rate equal to the opportunity cost of funds.

Decision Rule 2: To maximize net worth, choose among the various projects, or scenarios of projects, the one with the highest NPV. If investment is subject to a budget constraint, then choose the package of projects that maximizes the NPV of the fixed budget.

Decision Rule 3: When there is no budget constraint and when a choice must be made between two or more mutually exclusive projects, *e.g.*, projects being considered for the same building site, then investors who seek to maximize net worth should select the project with the highest NPV.

Rule 3 is stated in terms of the absolute value of the NPV, not in terms of the NPV per dinar of investment. For example, consider two projects, A and B, which are mutually exclusive for technical reasons and have the following characteristics:

Project A: NPV of project A = Dinars 700,000
Present value of capital expenditure = Dinars 4,000,000.

Project B: NPV of project B = Dinars 600,000
Present value of capital expenditure = Dinars 1,500,000.

According to Rule 3, Project A with an overall NPV of Dinars 700,000 should be chosen because it has the higher NPV, even though the NPV per dinar of investment is higher for Project B (0.4) than for Project A (0.175). The reason for choosing Project A is that even though it requires an incremental investment of Dinars 2,500,000, it yields an incremental gain in NPV of Dinars 100,000 over and above a rate of return equal to the discount rate on the incremental investment. By choosing Project B, an investor would have a NPV of Dinars 600,000, and any additional

funds are assumed to be invested in the capital market where they would have a zero NPV. Thus, by choosing Project A, an investor would be Dinars 100,000 better off, and Project A is the preferred choice.

Note that even though the NPV of the incremental net cash flows might be negative and a project would not appear attractive to private investors, it may create benefits for others in the form of economic externalities that should be captured in an economic analysis. If the economic benefits are sufficiently large to outweigh the economic costs, then the government, on the grounds of improving economic efficiency, would have reason to offer the private investors some financial assistance to make the project more attractive to them.

Investment projects can exhibit different time profiles for the expected incremental net cash flow either to total or equity capital over a project's life. For example, the figure below shows time profiles for three types of investment projects, namely:

(a) T
he investment expenditures initially cause the net cash flow to be negative, but once the expenditure is incurred the rest of the net cash flows are expected to be positive over the project's life.

(b) T
his profile is slightly different because after a few years of operations, the replacement of some of the project's machinery and equipment causes the net cash flow to become temporarily negative.

(c) T
he last profile also turns negative, but in this case it is due to a major expenditure at the end of a project, e.g., environmental regulations require a strip-mining site to be restored to its original condition. The criterion used to appraise investment projects must be applicable to any time profile of net cash flows. Unlike other possible criteria, the net present value criterion is the only one that meets this requirement.

Although the NPV criterion is used by large companies and by government agencies, they also use alternative criteria. Each of these alternatives has serious drawbacks compared to the NPV criterion and is therefore judged not only less reliable, but potentially misleading. When two or more criteria are used to appraise a project, there is always a chance that they will point to different conclusions, and a wrong decision could be made. This simply creates unnecessary confusion and possibly mistakes.

A government project analyst should be familiar with the shortcomings of these alternative criteria. Representatives of a government-owned and controlled corporation or a private company can often be quite adamant about the efficacy of their criteria as a basis for investment decisions. Although it is not necessary to tell these financial managers how to make decisions, nevertheless when a government project analyst wants to measure the gain to private investors from undertaking a project, then the NPV criterion should be employed.

Internal Rate of Return (IRR) Criterion

By definition, the IRR is the discount rate (ρ) that sets the NPV = 0 in the following equation:

$$\sum_{j=1}^{n} \frac{C_j}{(1+\rho)^j} - I = 0$$

where C_j = the incremental net cash flow to total, or equity, capital,

I = the initial investment,

ρ = the IRR. We have to solve for ρ.

This definition is consistent with the meaning of a zero NPV as explained in the previous section, namely that investors recover their invested capital and earn a rate of return equal to the discount rate, which is the IRR. The IRR can be calculated either with a hand calculator or on a computer spreadsheet. The internal rate of return criterion can be stated in the form of a set of decision rules.

Decision Rule 1: Do not accept any project unless its IRR is greater than the opportunity cost of the funds. Accept project if ρ > r, the opportunity cost of capital; otherwise, reject. The opportunity cost of capital is measured by the expected rate of return offered by other assets equivalent in risk to the project being evaluated.

Decision Rule 2: When a choice must be made between two or more mutually exclusive projects, then investors should select the project with the higher, or highest, IRR.

Table below lists the problems with the IRR criterion. We shall discuss them in turn.

Problems with the IRR Criterion

- The IRR may not exist.
- The IRR may not be unique. There could be multiple IRRs.
- Do you want ρ > r or ρ < r? Is the project like lending or borrowing?
- Wrong ordering of mutually exclusive projects, *e.g.*, projects of different scale.
- IRRs are not additive.
- IRR generally favours projects with shorter lives.
- IRR is independent of the timing of a project (*i.e.*, a project's start date), whereas NPV is sensitive to timing.

Problem No. 1: The IRR may not exist.

The IRR is mathematically speaking the root of an equation. The equation is based on the time profile of the incremental net cash flows. If the time profile crosses the horizontal axis from negative to positive only once then the root, or IRR, will exist, but it may not be positive. However, if the time profile crosses the axis more than once then there may be more than one root, or there may be no real roots, only imaginary roots. Although this is more of theoretical concern, it is a little disconcerting to know that an investment decision criterion may not have a solution.

blem No. 2: The IRR may not be unique. There could be multiple IRRs.

The discussion in Problem No. 1 above explains how there could be more than one root, or IRR, when the time profile of the net cash flows crosses the horizontal axis more than once. The possibility of having multiple IRRs can create some very practical decision-making problems.

Consider an example like Project B that has the following net cash flow in thousands of constant Dinars:

Time Profile of Net Cash Flow for Project B

Time Period	t_0	t_1	t_2	t_3
Net Cash Flows of B	-20	120	-220	120

Project B has IRRs of approximately 0%, 100%, and 200% (i.e., these roots will solve the IRR equation and set the NPV equal to zero). Let us assume that the private opportunity cost of capital is 6%. Would we accept this project?

Let us further assume that we are unaware of the foregoing discussion about multiple IRRs and that we have calculated only the IRR of 100%. A project with an IRR of 100% sounds very attractive, especially compared to the relatively low 6% cost of capital. Would we approve the project?

If we did agree to accept the project, the agency would be worse off, and the analysts might lose their jobs. The NPV of Project B calculated at the 6% opportunity cost of capital is -1.84 thousand. The investors would have been better off leaving their funds in the capital market rather than to invest in Project B.

The reason that Project B has a negative NPV despite an IRR of 100% was stated under Problem No. 1. Project B does not provide a stream of 100% return in which to invest the positive cash flows like the 120,000 Dinars in t_1 so that their compounded value can offset any subsequent negative net cash flows.

It is possible, of course, that we might have calculated the IRR of 0%. Since this IRR is less than the cost of capital, we would have applied the IRR criterion and rejected the project. This time we would have been correct, but we would not have known that until we had computed a project's NPV. And if we have the NPV, why would we need the IRR? If word gets around that we have just rejected a project with an IRR of 100%, or worse 200%, then we are likely going to have to provide more explanations. In the end, the IRR may introduce confusion and could result in costly mistakes.

blem No. 3: Do you want $\rho > r$ or $\rho < r$? Is the project concerned with lending or borrowing?

Consider a simple, two-period project like K below. The net cash flows are measured in thousands of Dinars and the opportunity cost of capital is 10%.

Project K is like lending; there is first a cash outflow followed by a cash inflow. In this case a high IRR is desirable. The IRR exceeds the cost of capital, so according to the criterion we would accept the project, and we would be correct. The NPV is positive and large.

Now consider a second two-period project like L below. The net cash flows are also measured in thousands of Dinars and the opportunity cost of capital is 10%.

Time Period	t_0	t_1	IRR	NPV (at 10%)
Net Cash Flows of K	-1,000	2,000	100%	818

Time Period	t_0	t_1	IRR	NPV (at 10%)
Net Cash Flows of L	+1,000	-2,000	100%	-818

What is different this time is that Project L is like borrowing; there is first a cash inflow followed by a cash outflow. In this case a low IRR would be desirable. However, if we were to apply the IRR criterion, the IRR exceeds the cost of capital, and so we would accept the project. Unfortunately, we would be in error. The NPV is negative and large (in absolute value), and the agency would be worse off.

In short, the standard IRR criterion gives the wrong decision if a project is similar to borrowing. Since the investment criterion chosen should apply to all projects, not just some, the IRR criterion should not be the preferred criterion.

Problem No. 4: Wrong ordering of mutually exclusive projects, *e.g.*, projects of different scale.

The problem of choosing between two or more mutually exclusive projects arises quite frequently. Examples would include two alternative buildings being considered for the same building site, or a new highway that could be constructed in two alternative ways. Whereas the NPV takes explicit account of the scale of the project by means of the investment that is required and the initial negative net cash flows that accompany it, the IRR ignores the differences in scale. The IRR is expressed as a rate per Dinar of investment and does not indicate on how many Dinars that rate can be earned.

For example, consider two two-period projects (M and N) with different scales of output. Assume that all the net cash flows are measured in thousands of Dinars and that the cost of capital is 10%.

Time Period	t_0	t_1	IRR	NPV (at 10%)
Net Cash Flows of M	-1,000	+1,500	50%	363
Net Cash Flows of N	-10,000	12,000	20%	909
			MIRR	Δ NPV
Incremental Project	-9,000	10,500	16.7%	546

If Decision Rule 2 of the IRR criterion were applied, then we would choose the project with the higher IRR. In this case that would be Project M. Once again, however, this would be a mistake. The NPV of Project N is Dinars 546 thousand higher.

The problem is that with Project M the *rate* of return is higher, but it is earned on only an investment of Dinars 1,000 whereas with Project N, the *rate* of return is lower, but the Dinar return is higher; hence the higher NPV.

Another way to view this problem is to think about how by accepting Project M, the remaining Dinars 9,000 is going to be invested. Lacking anything more concrete, it is best to assume that the Dinars 9,000 is invested in the capital market, where it would have a 10% rate of return and a NPV of zero. If instead the Dinars 9,000 were invested in Project N, there would be an additional net benefit of Dinars 546,000 over and above the 10% market return. Clearly, Project N is the better alternative. This is also indicated by the *marginal* internal rate of return (MIRR) on the incremental investment of 16.7% which is greater than the cost of capital.

Problem No. 5: IRRs are not additive.

Larger projects will frequently have a number of separable components. Each of these components should be analyzed on its own merits and then assessed in conjunction with the other components. Since some of the possible components may be mutually exclusive, those separate combinations have to be examined as well.

Take, for example, a larger three-period Project T that has two mutually exclusive projects, 1 and 2, and a third project 3 that has independent net cash flows, but that could be undertaken with either one of the other two. The question is which is the best package? In the table below, all the net cash flows are expressed in thousands of Dinar and the cost of capital is 10%; all of the *separate* projects have the same scale of investment.

Our objective is to maximize the NPV of Project T. The question is whether that will occur if we rely on the IRR criterion. According to the latter, Project 3 is the most attractive of the individual projects, and it remains the most attractive even after assessing it in combination with the other two. Hence, based on IRR Decision Rule No. 2, we would select Project 3 by itself.

Time Period (at 10%)	t_0	t_1	t_2	IRR	NPV
Net Cash Flows of 1	-100	0	550	135%	354
Net Cash Flows of 2	-100	225	0	125%	105
Net Cash Flows of 3	-100	450	0	350%	309

Project T Combinations:

Time Period (at 10%)	t_0	t_1	t_2	IRR	NPV
Projects 1 & 3	-200	450	550	213%	663
Projects 2 & 3	-200	675	0	238%	414

By assumption, the net cash flows of Project 3 are independent of the net cash flows of the two mutually exclusive projects. In other words, there are no complementarities or substitution possibilities that would cause the combined NPVs of either Projects 1 and 3, or 2 and 3, to differ from the sum of their individual NPVs. When either Project 1 or 2 is combined with Project 3, their combined NPV is substantially higher than Project 3 by itself. In fact, Projects 1 and 3 combined would be the best choice with a combined NPV over twice as high as Project 3 alone. Even Projects 2 and 3 combined would have been preferable. Unfortunately, the IRR criterion would *not* have resulted in these choices.

The reason for the problem is that whereas the NPVs are additive, the IRRs are not. When the separate projects were analyzed, they all had the same scale of investment, but the combinations increase the scale of investment and, therefore, should not be ordered according to the IRR criterion. In this case, the larger scale of investment lowers the IRRs of the combinations and makes them appear less attractive. The IRR of Projects 1 & 3 combined is less than the sum of the individual IRRs of Project 1 and Project 3.

blem No. 6:

IRR generally favours projects with shorter lives.

Examples of how the IRR is generally higher for shorter-lived projects are provided in the previous table (used for Problem No. 5). Compare Projects 1 and 2. The undiscounted positive net cash flow of Project 1 is twice as high as that of Project 2, except that Project 2's net cash flow occurs one year earlier. Despite the difference in the cash-flow magnitudes, the IRRs are quite close.

Also compare the combinations. The total of the undiscounted positive net cash flows of Projects 1 & 3 is considerably larger than that of Projects 2 & 3. Yet the IRR of Projects 2 & 3 is higher because the net cash flows occur earlier.

Problem No. 7: IRR is not sensitive to starting time while NPV is.

Consider the same project but started at different times

Alternative A:
Investment costs = 1,000 in year 0
Benefits = 1,500 in year 1
Alternative B:
Investment costs = 1,100 in year 2
Benefits = 1,670 in year 3

NPVA : $-1{,}000 + 1{,}500/(1.08) = 388.88$
NPVB : $-1{,}100/(1.08)^2 + 1{,}670/(1.08)^3 = 382.6$
Hence, NPVA > NPVB

IRRA : $-1{,}000 + 1{,}500/(1+KA) = 0$
$KA = 0.5$
IRRB : $-1{,}100/(1+KB)^2 + 1{,}670/(1+KB)^3 = 0$
$KB = 0.52$
Hence, KB>KA

Thus the IRR criterion would prefer project B to A while it will generate a lower net benefit compared to project B.

Benefit-Cost Ratio (BCR) Criterion

As its name indicates, the benefit-cost ratio, or what is sometimes referred to as the profitability index, is the ratio of the NPV of the net cash inflows (or economic benefits) to the NPV of the net cash outflows (or economic costs):

$$BCR = \frac{NPV of Net Cash Inflows (or Economic Benefits)}{NPV of Net Cash Outlows (or Economic Costs)}$$

The benefit-cost ratio criterion can be stated in the form of a set of decision rules.

The BCR Criterion

Decision Rule 1: Do not accept any project unless its BCR is greater than one. Accept project if BCR > 1; otherwise, reject. The NPVs in both the numerator and the denominator of the ratio should be discounted by the opportunity cost of the funds. The opportunity cost of capital is measured by the expected rate of return offered by other assets equivalent in risk to the project being evaluated.

Decision Rule 2: When a choice must be made between two or more mutually exclusive projects, then investors should select the project with the higher, or highest, BCR.

Many government agencies around the middle-east (MENA) started using the NPV criterion as the main basis for decision-making in the economic analysis of a project, but they have in the past used the BCR and the Economic IRR as indicators of economic desirability. To use the BCR as a measure of financial or economic desirability runs the risk of screening out possible candidate projects according to a faulty criterion. In some instances, worthy candidates could be eliminated from consideration early on based on their BCRs, and in so doing the overall NPV could be lowered unnecessarily. As illustrated below, furthermore, the NPV criterion and the BCR criterion can often draw the opposite conclusion. Using the two criteria together then becomes a source of confusion, and possibly mistakes.

Although the BCR is popular because it is a handy rule-of-thumb and summary statistic, it does have two major weaknesses, as discussed below:

Problem No. 1: The BCR is sensitive to the definition of costs. Problem of recurring capital costs.

When a project profile is drawn, it is not uncommon to have negative net cash flows in some years during the project's life. The question is should these periodic negative net cash flows be included in the capital costs in the denominator or should they be counted as net cash flows (albeit negative) in the numerator. The problem is that the BCR is a ratio. Whereas multiplying or dividing the numerator *and* denominator of a ratio by the *same* number does not alter

the size of the ratio, adding or subtracting the *same* number to the numerator *and* denominator of a ratio will alter its magnitude.

Consider two projects, V and W, where Project W has substantial recurring capital costs in comparison to its initial capital costs. All the NPVs of the cash flows (or economic benefits and costs) are measured in thousands of Dinars, and the cost of capital is 10%.

By applying Decision Rule No. 2 of the BCR criterion to the project with recurring capital costs netted out of net cash *in*flows (the first approach above), Project W appears to be more attractive than Project V. However, when the NPV of recurring capital costs is instead added to the NPV of initial net cash *out*flows (the second approach), then Project V appears to be more attractive than Project W. Which approach is correct?

The answer is that they are both arbitrary and could easily be used indiscriminately by different project analysts. The problem is that decision-makers would not necessarily know which approach is being used, and even if they did, they would not know which was correct until they examined the NPVs of the two projects. In the above example, Project V is the better project because it has the higher NPV. With the NPV, there is no need to inquire further.

	Project V	Project W
NPV of gross net cash *in*flows (or gross economic benefits)	2,000	2,000
NPV of initial net cash *out*flows (or initial capital costs)	1,200	100
NPV of recurring net cash *out*flows (or recurring capital costs)	500	1,800
NPV of all net cash flows	300	100

Alternative Approaches:

BCR when the recurring capital costs are netted out of the net cash *in*flows (or gross benefits)	$BCR^V = \frac{2,000 - 500}{1,200}$	$BCR^W = \frac{2,000 - 1,800}{100}$
	$= 1.25$	$= 2.00$
BCR when the recurring capital costs are added to the initial net cash *out*flows (or initial capital expenditures)	$BCR^V = \frac{2,000}{1,200 + 500}$	$BCR^W = \frac{2,000}{1,800 + 100}$
	$= 1.18$	$= 1.05$

Problem No. 2: Wrong ordering of mutually exclusive projects, *e.g.*, projects of different scale.

This problem is basically the same as Problem No. 4 with the IRR criterion, namely that the BCR is a measure of return *per* Dinar of investment. The BCR does take account of the differences in the scale of investment. As was evident from the example in Problem No. 1 above, the BCR is also very sensitive to the magnitude of the initial investment costs.

Consider another example of three mutually exclusive projects X, Y, and Z; none of these projects has any recurring capital costs. All the NPVs of the cash flows (or economic benefits and costs) are measured in thousands of Dinars, and the cost of capital is 10%.

Decision Rule No. 2 of the BCR criterion would rank these projects as follows: Project Z > Project X > Project Y. Compare this ranking with the ordering according to their NPVs: Project Y > Project Z > Project X. The reason that Project Y appears to be the least attractive according to the BCRs is that its relatively large initial capital expenditure lowers the return *per* Dinar of expenditure. In fact, however, an agency would be better off earning a 0.175 Dinar return per Dinar of a Dinars 8 million investment (Project Y) rather than a 0.40 Dinar return per Dinar of a Dinar 1.5 million investment (Project Z).

There are other project selection criteria such as the payback period, the average rate of return on the book value of the investment, which is an accounting, rather than a finance concept, and the modified IRR. All of these criteria have weaknesses

relative to the NPV criterion that is recommended by this Manual and most textbooks in corporate finance theory. Therefore the alternative criteria are not analyzed here.

	NPV of capital costs	NPV of net cash *in*flows	NPV of project	BCR
Project X	1,000	1,300	300	1.3
Project Y	8,000	9,400	1,400	1.175
Project Z	1,500	2,100	600	1.4

Chapter VI: Financial Analysis of a Project

CHAPTER VI: THE FINANCIAL ANALYSIS OF A PROJECT

Introduction

The financial analysis of a project helps determine the financial sustainability of the project and its overall success. In its simplest form, one can describe the financial analysis of a project as a process that entails the organization of specific data requirements in certain statements, followed by the application of certain investment criteria to these statements to determine the financial profitability or sustainability of the project. This process requires an understanding of the concepts, principles and common conventions that underlie a correct financial appraisal. Moreover, the understanding of these concepts and principles is important in defining the data requirements for conducting the financial appraisal of the project.

This chapter presents the concepts and principles that are necessary to use the data in constructing financial profiles for the project's receipts and expenditures over the project's life. These financial profiles are known as the project's cash flow statements.[8]

[8] The cash flow statement is the main financial statement used to assess a project's viability. Other financial statements may be also used to assess a project's viability but play different roles. The statement of profit and loss, for example, helps determine a project's net income, and subsequent tax liability, following the accounting rules. Unlike the cash flow statement, the income statement is not concerned with actual cash inflows that pay dividends and outflows that finance expenditures, and help determine the value of the project. Also, the balance sheet and the statement of sources and applications of funds cannot alone determine the viability of a project.

The chapter is largely a "hands-on" chapter. It presents the concepts and principles underlying a financial analysis, provides illustrations for most of these concepts and offers practical guidelines for the actual construction of a financial cash flow statement and the analysis of these statements. While the bulk of the chapter deals with the nuts and bolts of a financial analysis, several annexes provide additional information.

Why a financial appraisal for a public sector project?

It may appear that the financial appraisal of a project is only of interest to a private investor who wishes to determine the net financial gain (or loss) resulting from a project. From a country's point of view, a project will increase the country's net wealth if it has net positive *economic* returns. Conversely a project that yields negative economic returns should not be undertaken as it would lower the net wealth of society as a whole. Consequently, one may expect the emphasis of the appraisal of government projects to be on the economic analysis of projects only. Indeed, when appraising projects in the 1960s and 1970s, the emphasis of development institutions was on the economic appraisal only. Why then do we need to conduct the financial appraisal of a public-sector project in addition to its economic analysis and why is more attention being paid to the financial analysis now than in the 1960s and 1970s?

Financial Sustainability

There are several reasons to conduct a financial appraisal for a government project. The most important one is to ensure the availability of funds to finance the project through its investment and operating stages. It has become increasingly clear that while positive economic returns are *necessary* for the success of the project, they are by no means *sufficient* reason for its success. In other words, a project that has high economic returns may very often fail if there are not enough funds to finance the operations of the project.

Examples of development projects with expected high economic returns that have failed due to financial difficulties abound. Water supply projects are typical examples of projects that have large economic benefits due to the large value attached to water, and low financial receipts due to the low water tariffs. If the project is undertaken solely on the basis of the favorable economic analysis with no consideration given to the financial sustainability, the project may very well fail due to lack of funds to maintain the system, and/or service the debt. The reduction in, or lack of, maintenance results in continuously increasing water losses and reduces the anticipated economic benefits of the system. Other examples include projects from energy, transport, and irrigation sectors where services are usually provided at concessional rates.

Thus, a financial analysis enables the project analyst to establish the financial sustainability of the project by identifying any financing shortfalls that are likely to occur during the investment and operating stages of the project, and by devising the necessary means for meeting these shortfalls. Simply put, one of the main objectives of a financial appraisal for a government project is to determine whether a project can continue "to pay its bills" throughout its entire life or not; and if not, how can the shortfalls be met.

Distributional Impacts

The second reason for conducting a financial appraisal of public-sector projects is directly related to understanding the distributional impacts of the project. For example, the difference between the financial price an individual pays for a liter of water (extracted from the financial cash flow statement) and the gross economic benefit he derives from consuming the water (derived from the economic resource flow statement) reflects a net gain to the consumer. Similarly the difference between the financial price inclusive of tax that a project faces and the economic cost of an input required by the project measures the tax gain to the government. Gains and losses of this nature will be more difficult to establish on the basis of economic analysis only.[9]

Profitability

[9] The distributional analysis is presented in detail in a later chapter. The actual estimation of distributional impacts for sector specific projects is presented in each case study.

In certain instances, to determine the financial profitability of the project, the government approaches a project like a private sector investor. This is necessary if privatization of the project is being considered. To estimate the value that a private investor would be willing to pay for the project, it is essential to determine the profitability of a project. Ascertaining the financial profitability is also necessary when government policies are designed to encourage small investors and certain groups in society to undertake projects by providing them with grants or loans. The government's decision to provide grants or loans to the sponsors of these projects is still based on whether the entire project yields positive economic returns or not, and whether it is financially sustainable or not. However, the small investor is concerned primarily about the financial profitability of the project and will undertake it only if it is likely to make him better off. Consequently, the government should appraise the project financially from the point of view of a single investor to determine whether it is profitable. In case the project is not profitable from the point of view of a single investor while the project generates positive net economic benefits, the government has to provide subsidy or budgetary support to the investor.

Financial Cash Flows: Concepts, Principles and Conventions

What is a financial cash flow statement?

The financial cash flow statement of a project is a profile of the project's receipts and expenditures over time. The cash flow statement is organized in two main sections. The first section typically contains the expected financial receipts generated by the project, while the second one contains the expected financial expenditures incurred to generate the receipts of the project. The project's total expenditures, also known as total outflows, are subtracted from its receipts (inflows) to provide the net cash flow from the project. The table below is an illustration of some of the line items that may appear in the financial cash flow statement of a project. At this early stage of the presentation, the table is only intended to give an idea of the type of variables that are included in a cash flow statement, and how they are organized in the statement. This table will also be referred to later when discussing some of the variables that make up a cash flow statement.

Table
Organization of Variables in a Financial Cash flow Statement

Financial Receipts:

1. Sales
2. Changes in Account Receivable
3. Residual Values
(a) Land
(b) Equipment
(c) Buildings
4. Total Inflows

Financial Expenditures:

(i) Investment Expenditures/Opportunity Costs

5. New investment

(a) Land
(b) Type 1 Equipment
(c) Type 2 Equipment
6. Buildings
7. Existing Assets (if any)
(a) Land

(b) Equipment

8. Buildings

(ii) Operating Expenditures

9. Raw material (1)
10. Raw material (2)
11. Raw material (n)
12. Management
13. Skilled labor
14. Unskilled labor
15. Maintenance
16. Changes in Account Payable
17. Changes in Cash Balance
18. Total Outflows

19. Net Cash Flow

The figure below illustrates four of the different profiles that a net cash flow can have. Each profile is a plot of a project's receipts net of expenditures (net cash flows) against the sequence of years that make up the project's life. Typically, a project's net cash flow is negative in the early part of a project's life (the investment stage) when the initial investment is being undertaken and the project is not generating any receipts. Once the investment is completed and the project starts operating, the net cash flow is likely to be positive. This is depicted in Panel A. While this is the profile commonly used to present a project's net cash flow, it is not the 'standard' profile for most projects.

Panel B presents an alternative situation where a period of reinvestment or plant retooling is planned during the life of the project. This may result in negative net cash flows during the operating life of the project. Panel C presents a profile for a class of projects that require a large expenditure at the end of the project. The expenditure could be, for example, attributed to clean-up and landscaping costs associated with a mining project, or the decommissioning of a power plant. The profile of the net cash flow in Panel D represents projects that do not generate any financial receipts (road projects that charge no tolls), or projects that generate low receipts that are insufficient to cover operating expenditures (possibly water and wastewater projects). In such cases, the project will have a large initial outlay during the investment stage and will continue to show negative net cash flows during the operating stage.

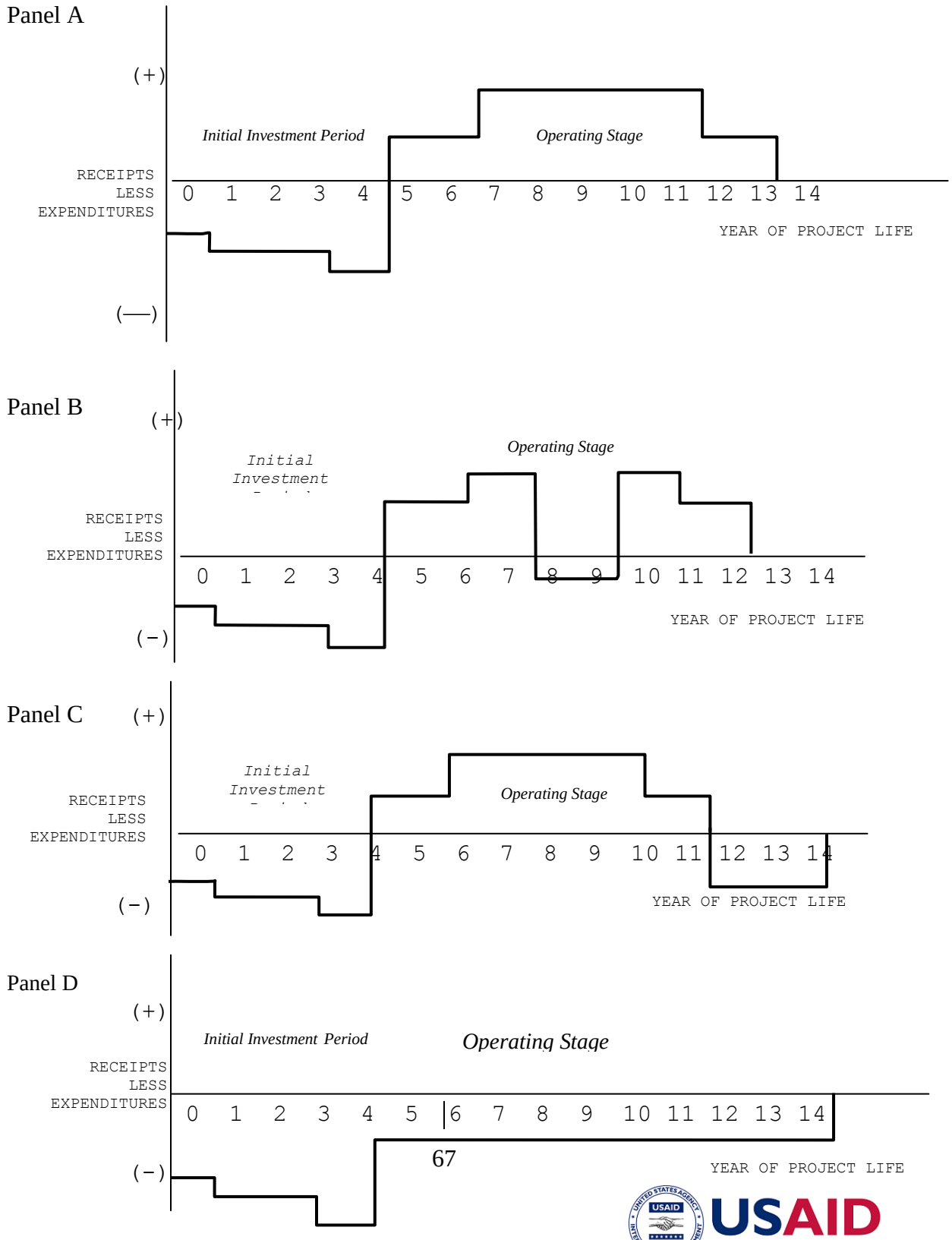
Components of a Cash Flow Statement

The construction of the cash flow statement depicted in table above is generally preceded by the chronological organization of variables and data into three stages: an investment stage, an operating stage, and a cessation-of-operations stage. Each of these stages corresponds to a plan. Most of the data required for these three plans should be already organized in the technical, demand, manpower, and financing modules discussed earlier. Rules for including variables and data in the cash flow statement are presented and discussed for each of the three plans. There is however one simple guideline that can be mentioned here. "Only cash impacts are included in the cash flow statement, with one exception. This exception is the opportunity cost of existing assets."[10]

This guideline is applicable to the construction of the cash flow statement as a whole and can help the analyst when in doubt whether a variable should be included in the cash flow statement or not.

[10] The opportunity cost of existing assets is discussed below in the section dealing with existing assets under the investment plan.

Figure
Different Financial Project Profiles



Investment Plan

The first step in the construction of a financial cash flow statement is the formulation of an investment plan for the project based on the information developed in the technical, demand, manpower, and financing modules. The investment plan consists of two sections: the first deals with the expenditure on new acquisitions, and the opportunity cost of existing assets, and the second section deals with the financing aspects of the proposed investment. If there are different scales and/or locations under consideration, corresponding investment plans for each scale and/or location should be formulated.

The table below provides an illustration for sections an investment plan for a water supply project. All data in the investment plan regarding the expenditures on new acquisitions, and the opportunity cost of existing assets, if applicable, are included in the cash flow statement. Financing data is included in some statements but not others depending on the point of view as explained below[11].

Data and Data Breakdown

Once time schedules and deadlines are formulated, expenditures should be broken down by year of expected expenditure. Expenditures on internationally traded items should be separated from expenditures on items that are not traded internationally. This breakdown is important for analyzing foreign exchange implications and later for estimating the economic costs associated with these expenditures. Each expenditure item should be broken down into its components, whenever possible and appropriate. For example, the final cost of an installed plant should be broken down by what suppliers receive, import tariffs, value added taxes, and/or any other payment to the government, freight charges, handling charges, installation costs, etc. Investment credits or other forms of subsidies should be explicitly presented.

Civil works and building construction should be broken down into raw material, and the different types of labor. These breakdowns are necessary for conducting the economic analysis of the project and are also important for providing a clear understanding of its cost structure. Moreover identifying the recipients of the various payments enables the project analysts and economists to determine some of the beneficiaries of the project.

The first section of table below presents the investment expenditures for the water supply project in the manner described above.

[11] The sales revenues and cash expenditures in a project will occur almost on a continuous basis. However, these inflows and outflows have to be lumped together for each time period that may be a year, a quarter or a month. In this manual, as a matter of convention, all inflows and out flows are supposed to occur at the end of the corresponding time period. One could very well assume that they all occur at the beginning of the time period. The important thing is to adopt any one of these conventions and then be consistent.

Table
Investment Plan for a hypothetical water supply project

Investment Expenditures

	YEAR 1			YEAR 2			YEAR 3			YEAR 4		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
Water reservoirs/pumping stations												
Civil works	5.3	2.3	7.6	13.0	5.6	18.6	8.8	3.8	12.6	1.2	0.5	1.7
Equipment and materials	0.5	2.1	2.7	1.6	6.3	7.9	0.7	3.0	3.7	0.2	0.9	1.1
Transmission mains												
Civil works	1.8	4.2	6.0	2.3	5.4	7.7	1.6	3.8	5.4	0.3	0.7	1.0
Equipment and materials	2.2	9.0	11.2	2.8	11.4	14.2	2.0	8.1	10.1	0.4	1.5	1.9
Secondary/Tertiary networks												
Civil works	11.2	3.7	14.9	26.0	8.7	34.7	29.8	9.9	39.7	7.4	2.5	9.9
Equipment and materials	4.5	17.9	22.3	10.4	41.7	52.1	11.9	47.6	59.5	3.0	11.9	14.9
Service connections												
Civil works	8.3	1.5	9.7	19.3	3.4	22.7	22.0	3.9	25.9	5.5	1.0	6.5
Equipment and materials	1.9	7.8	9.7	4.5	18.1	22.7	5.2	20.8	26.0	1.3	5.2	6.5
Office buildings	3.7		3.7	3.7		3.7	0.0					
Consulting services	1.1		1.1	0.5		0.5	0.3		0.3			
Land cost	25.0		25.0									
In-house eng. Services	16.3		16.3	16.3		16.3	12.2		12.2	4.1	0.0	4.1
Taxes and duties	12.4		12.4	25.6		25.6	25.7		25.7	6.3	0.0	6.3
Total	94.2	48.5	142.7	126.1	100.5	226.6	120.4	100.8	221.2	29.7	24.1	53.8

Summary of investments	Year 1	Year2	Year 3	Year 4
Civil works	38.3	83.6	83.7	19.1
Equipment and materials	46.0	96.8	99.3	24.3
Office buildings	3.7	3.7		
Consulting services	1.1	0.5	0.3	
Land cost	25.0			
In-house eng. Services	16.3	16.3	12.2	4.1
Taxes and duties	12.4	25.6	25.7	6.3
Total	142.7	226.6	221.2	53.8

Financing

	Year 1	Year 2	Year 3	Year 4
Foreign Loans	117.7	160	160	53.8
Domestic Equity	25	66.6	61.2	

Opportunity cost of existing assets

If the project under consideration is an ongoing concern or a rehabilitation project where some of the project's old assets are integrated into the proposed facilities, the opportunity cost of these assets should be included in the cash flow statement together with the expenditure on new acquisitions. See box below for why it is necessary to include the opportunity cost of an existing asset in the cash flow statement.

It is necessary to distinguish the "opportunity cost" of an asset from the "sunk cost" of an asset. The opportunity cost of using an asset in a specific project is the benefit foregone by not putting the asset to its best alternative use. To measure the opportunity cost of an asset, a monetary value has to be assigned to it that should be equal to what has been sacrificed by using it in the project rather than in its next best use. On the other hand, the value of an asset is treated as a sunk cost if the asset has no alternative use. The opportunity cost of such an asset is zero.

For the sake of illustration, take an asset that has been purchased by a firm and it can be used to make only one product and nothing else. Also, it cannot be leased to any other firm and its scrap value is negligible. In other words, the asset has no alternative value except in its current operations. Clearly its opportunity cost is zero. Sunk cost involves neither current nor future opportunity cost and therefore should have no influence in deciding what will be the most profitable thing to do. It should, however, be noted that while the sunk cost of an asset should not be counted as a cost to a new project in examining its feasibility, any outstanding liabilities due to that asset may become the liability of the new project if the ownership is the same.

Major items of the existing assets should be broken down, similar to the expenditure on new acquisition into traded and non-traded and into a reasonable number of components whenever possible. The opportunity cost of the existing assets is generally included in the first year (conventionally year 0) of the project's cash flow profile. This is because the assets could be sold at that time if the project is not feasible.

The financial opportunity cost of an existing asset is the highest financial price that it could be sold for. The financial price paid for the assets when they were first acquired is irrelevant and should never be used to reflect the opportunity cost of an asset. The highest financial price is typically the higher of the in-use value of the asset and its liquidation value. The in-use value of the asset is what it would sell for if it were to be used as an ongoing concern. The liquidation value is what the asset would sell for if broken into its different components and sold in parts. For example, when considering the opportunity cost of any production plant, one should consider the in-use value of the plant if it continues to be operated as is, and its financial value if dismantled and the different parts are sold separately.

The most accurate way to determine in-use and liquidation values is through reliable market assessors. When estimating in-use values using assessors, the assessor's fees should be subtracted from the quoted value to obtain the net

in-use value. Also when assessors give a liquidation value for a project's assets, the assessors' fees as well as the expenditures incurred in dismantling the assets should be netted from the quoted price to obtain a net liquidation value.

In the absence of an assessor, a rough estimate of the plant's value can be obtained by using the rate of *economic* depreciation of the assets. The economic depreciation rate for an asset reflects the loss in the market value of the asset and is generally different from the depreciation rate used for tax purposes. Economic depreciation rates for plants and equipment may be obtained from the plant manufacturer; technical journals may contain information on depreciation patterns; also insurance companies that insure a plant's assets have some estimates for the plant's rate of economic depreciation.

Suppose the installed cost of a wastewater treatment plant was A_0 in 1995. Also suppose that the plant has an economic life T, and that the plant's annual rate of economic depreciation is d_e. If the price index has risen from I_{1995} to I_{2005}, the in-use value of the plant can be estimated as follows:

In-use value (2005) = $A_0 \times (1 - 10 \times d_e) \times (I_{2005} / I_{1995})$

In a case where the rate of economic depreciation is the same as the rate of straight line depreciation,

In-use value (2005) = $A_0 \times (1 - 10/T) \times (I_{2005} / I_{1995})$

The term in the first set of parentheses represents the remaining proportion of the value of the plant in purchasing power of 1995, and the term in the second set of parentheses adjusts the in-use value of the asset from the 1995 price level to the 2005 price level.

Investment financing

The second half of the investment plan deals with the means and schedules of financing the investment expenditures. This data should be largely prepared in the financing plan already discussed. The sources of finance used whether equity or grants, domestic short term and long term loans, foreign loans, suppliers' credit, concessionary loans and other forms of foreign aid should be identified and the disbursement schedules should be formulated. The second section of the investment plan illustrated in the table above presents an example of a financing plan.

Whether the data in the financing section of the investment plan is included in the cash flow statement or not depends on the point of view considered. When appraising the project from an owner's point of view, the loan disbursement is an inflow, and the repayment is an outflow as the owner is looking to the net receipts after paying any debtors or other shareholders. The analysis of the financial performance of the total invested capital, however, is not concerned with the financing but is looking to determine the financial viability of the project to all investors irrespective of the sources and terms of financing. Different points of view are discussed below.

Operating Plan

The operating plan is developed on the basis of the data formulated and organized in the technical, demand (market), and manpower modules. It

includes all cash receipts generated from the operations of the business and all operating expenditures. Expenditures and corresponding receipts should be projected by year of operation. Similar to investment expenditures, data breakdowns are necessary in operating plan as well. Operating expenditures should be broken down into internationally-traded and internationally non-traded items; and each expenditure item should be broken down into its components, whenever possible. For example, maintenance expenditures should be broken down into materials and labor. Expenditures on different types of labor (skilled, unskilled, etc.) should be identified and recorded separately. Any taxes or subsidies associated with the operating expenditures should also be identified and recorded separately whenever possible. These breakdowns are necessary for conducting the economic analysis of the project and for providing a better understanding of the cost structure of the operating expenditures. The following table presents an illustration of an operating plan for a hypothetical water supply project.

Direct data requirements for a cash flow statement are slightly different from, and may not be as readily available as data requirements for income statements and balance sheets.[12] For example, an income statement includes sales and purchases, while a cash flow statement includes receipts and expenditures. Sales and purchases include credit as well as cash transactions, while receipts and expenditures are cash only. Even though direct data requirements for cash flow statements may not exist, a cash flow statement can be constructed from the information in a set of balance sheets and income statements. A few important distinctions between variables included in a cash flow statement and variables in other financial statements are discussed below. The distinction generally stems from the fact that non-cash impacts (with the exception of opportunity costs) are not included in the cash flow statement.

Adjustment of Sales

Needless to say, a project's viability is not only determined by the sales it generates but also by the timing of the cash receipts from the sales. A cash flow statement records sales transactions only when the cash from the transaction is received. Typically projects forecast their sales as a single line item which comprises both credit and cash transactions. Only cash sales are included in a cash flow statement. Many government projects and firms provide their goods and services to their customers without receiving immediate cash payments. Reasons for this vary. In some cases, it could be government policy to provide such credits, which indeed serve as short-term credit, to assist certain project sponsors. In other cases, a credit sale could be involuntary where it takes the customers several months to pay for the services they consume, such as in the case of water and electricity.

A distinction must be made between sales and cash receipts. When a project makes a sale, the good or service may be delivered to the customer but no money

[12] One of the main reasons for more readily available information for balance sheets and income statements is that these statements are often required by law for disclosure and tax purposes.

transferred from the customer to the project. At this point the project's accountants will record that the project has an asset called Accounts Receivable (AR) equal to the amount of the sale, or the proportion of it that was not in cash. In other words, the buyer owes the project for the goods or services that he has purchased and not yet paid for. Until the buyer has paid for what he has received, the transaction will have no impact on the cash flow statement. When the buyer pays for the items that he previously bought from the project, the project's accountant records a decrease in accounts receivable by the amount that the buyer has paid and an increase in cash receipts. Only then are these cash receipts included in the cash flow statement as inflows.

The cash receipts for any period equals the sales during the period plus the accounts receivable at the beginning of the period less the accounts receivable at the end of the period. The maximum amount of cash a project can receive during a period of time would be equal to the new sales and the outstanding receivables, if any. However if a balance of accounts receivable that has not been collected remains at the end of the period, then this balance should be netted from the maximum.

This is illustrated in the figure below. The project makes 1000 Dinars worth of sales during the first year, of which 600 Dinars are in cash and 400 Dinars are on credit. The cash inflow for this year should be 600 Dinars and not 1000 Dinars. Suppose the project's sales are 2000 Dinars during the second year, and at the end of the year, the outstanding receivables owed to the project are 500 Dinars, then the cash receipts for this year would be 1900 Dinars. These are estimated as the beginning balance of accounts receivables (400 Dinars) plus the new sales during the year (2000 Dinars) less the final balance of accounts receivable (500 Dinars). If all the project's sales for the year were cash and all accounts receivable were collected, then cash receipts for the year would have been 2400 Dinars. However, given that a remaining balance of 500 Dinars in receivables, actual cash receipts are only 1900 Dinars.

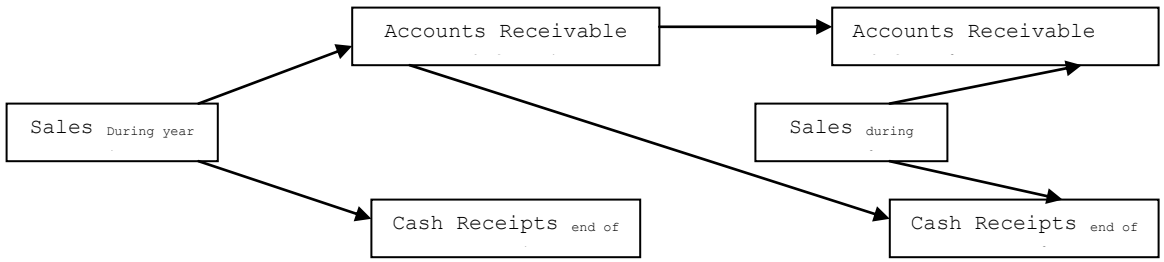
Table
Operating Plan for a Hypothetical Water Supply Project: (A few years only)

Operations and Maintenance	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Personnel								
Connections/employee	95	100	100	100	100	100	100	100
Total employees	99	262	457	457	457	457	457	457
Unit salary/mo. (Dinars)	4,245	4,330	4,416	4,505	4,595	4,687	4,780	4,876
Total personnel cost	5,058	13,629	24,219	24,703	25,198	25,702	26,216	26,740
Power/Fuel (Dinars/cum.)	8,961	13,011	16,672	16,672	16,672	16,672	16,672	16,672
Chemicals	16,842	16,842	16,842	16,842	16,842	16,842	16,842	16,842
Maintenance			8,439	8,439	8,439	8,439	8,439	8,439
Total	30,861	43,482	66,172	66,656	67,150	67,654	68,168	68,692
Production Schedule								
Connections								
Beginning		38,839	48,271	65,071	81,624	97,746	112,440	122,632
New		9,432	16,799	16,553	16,122	14,694	10,193	6,501
Ending	38839	48,271	65,071	81,624	97,746	112,440	122,632	129,133
Cumulative new connections		9,432	26,232	42,785	58,907	73,601	83,793	90,294
No. of persons/connection	8.4	8.0	7.5	7.5	7.5	7.5	7.5	7.5
Ave. consumption/person (liters/day)	150	160	200	220	220	220	220	220
Total consumption (cum./day)	48,937	61,787	97,606	134,679	161,280	185,526	202,343	213,070
Incremental consumption (cum./day)		12,850	48,669	85,742	112,343	136,589	153,406	164,133

Working Capital							
*Number of months accounts receivable		3	3	3	3	3	3
Accounts receivables	0	7.42	30.16	57.40	81.43	107.07	129.97
Change in accounts receivable		(7.42)	(22.74)	(27.25)	(24.03)	(25.64)	(22.90)
Cash balance	0	4.07	8.64	14.63	19.09	23.86	28.82
Change in cash balance		(4.07)	(4.57)	(5.99)	(4.46)	(4.78)	(4.96)
Accounts payable	0	8.85	14.39	23.12	27.89	32.89	38.29
Change in accounts payable		(8.85)	(5.54)	(8.72)	(4.77)	(5.00)	(5.40)

* A three month of accounts receivable implies that water bills are collected after three months of actual supply of water.

Figure
Schematic representation of the relationship between sales and cash receipts



Cash receipts $_{\text{for the period}}$ = Sales $_{\text{for the period}}$ + AR $_{\text{beginning of period}}$ — AR $_{\text{end of period}}$

Cash receipts $_{\text{for year 1}}$ = 1000 + 0 — 400
= 600 Dinars

Cash receipts $_{\text{for year 2}}$ = 2000 + 400 — 500
= 1,900 Dinars

Accounts receivable are typically measured as a percentage of sales. To determine the appropriate percentage of accounts receivable that a project will maintain, one can examine the current performance of the government department or corporation if the project is of a similar nature. If such information is not available, one should examine the industry standards or ranges. It is important to ensure that the accounts receivable selected for the project are consistent with the current performance of the department or industry standards. If not, plausible explanation should be given for why the proposed accounts receivable are different. For example, if a water supply project is proposing accounts receivable of 2 months while the current practice is 4-5 months, there must be a convincing reason why a change is proposed and how it will be actually affected.

Also when dealing with accounts receivable, it is important to assess the likelihood for bad debts and to make allowances for them. Bad debts occur when a project's customers default on their payments. Bad debts would lower the cash inflows to the project and need to be accounted for so that the cash flow statement is as realistic as possible. If accounts receivable at the end of the project operations are generally harder to collect, this should also be reflected in the cash flow statement.

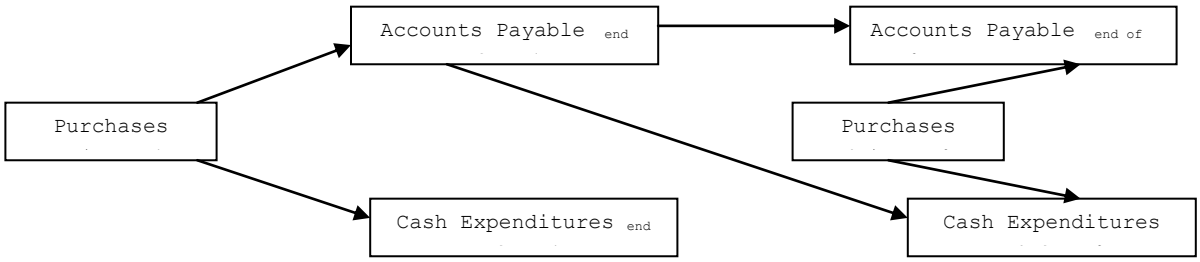
Adjustment of Purchases

Similar to the distinction between sales and receipts, a distinction is necessary between purchases and cash expenditures. The transaction is recorded in the cash flow statement only when the cash from the transaction is paid. When the project makes a purchase, the good or service may be delivered to the project but no money transferred from the project to its vendor. At this point the project's accountant records that the project has a liability called Accounts Payable (AP) equal to the amount of the purchase, or the proportion of it that

was not in cash. In other words, the project owes the seller for the goods or services that it has purchased. Until the project has paid for what it has received, the transaction has no impact on the cash flow statement. When the project pays the vendors for the items it has bought from them, the project's accountant records a decrease in accounts payable by the amount that the project has paid and an increase in cash expenditures. These cash expenditures are included in the cash flow statement as outflows.

The cash expenditures for any period equals the purchases during the period plus the accounts payable at the beginning of the period less the accounts payable at the end of the period. The maximum cash expenditures that the project could make during a period equal the new purchases during the period plus the settlement of any outstanding accounts payable. However, if the project still maintains a balance of accounts payable at the end of that period, then the expenditures for the period is determined by subtracting the ending balance of the accounts payable from the maximum that the project could have paid. This is illustrated in the figure below.

Figure



Cash expenditures $_{\text{for the period}}$ = Purchases $_{\text{for the period}}$ + AP $_{\text{beginning of period}}$ – AP $_{\text{end of period}}$

Cash expenditures $_{\text{for year 1}}$	=	1000	+	0	-	600
	=	400				
Cash expenditures $_{\text{for year 2}}$	=	2000	+	600	-	500
	=	2100				

Suppose the project purchases inputs for 1000 Dinars during the first year of the project's operations. Sixty percent of these purchases are on a credit basis. Cash expenditures relating to purchases for the year are 400 Dinars and not 1000 Dinars. Suppose that the project purchases additional inputs worth 2000 Dinars during the second year, and at the end of the year, the remaining accounts payable to be paid by the project are 500 Dinars, then the cash expenditures for this year would be 2100 Dinars. These are estimated as the beginning balance of accounts payable for the year (600 Dinars) plus the new purchases during the year (2000 Dinars) less the final balance of accounts payable (500 Dinars). If all the project's purchases during the year were paid for in cash and all outstanding accounts owed by the project were paid, then cash expenditures for the year would have been 2600 Dinars. However, given that there is a remaining balance of 500 Dinars in accounts payable, actual cash expenditures are only 2100 Dinars

Accounts payable are typically measured as a percentage of total purchases or that of a major input. The appropriate amount of accounts payable that a project will maintain can be determined on the basis of the current performance of the government department if the project is of a similar nature. If such information is not available, one should examine the industry standards or ranges. It is important to ensure that the accounts payable on which the cash flows will be based are consistent with the industry norms.

Adjustment for Changes in Cash Balance

Increases and decreases in cash balances owned by the project can take place even when no change occurs in sales, accounts receivable, purchases or accounts payable. For example, when cash is set aside for the transactions of the business, it is a use of cash which is represented as an outflow in the cash flow statement. Similarly a decrease in cash held by the project is a source of cash for the project and its sponsors, and is a cash inflow. Note that any cash set aside will ultimately all be released back to the project as an inflow at the end of the project.

The amount of cash to be held for facilitating the transactions of the business is typically a percentage of the project's expenditures, sales, or major purchases and it can be determined by examining the performance of similar projects in the same sector or industry.

To illustrate how changes in the cash balance are incorporated in the cash flow statement, consider the following example. Suppose that a project has the sales profile given below and that the project's cash balance for any time period is 20% of the project's projected sales for that time period. Note that the initial amount of cash balance (20,000 Dinars) is treated as a cash outflow because this amount has to be set aside. Subsequent increases also represent outflows. At the end of the project's operations when holding cash is no longer necessary, the entire amount of cash held (38,000 Dinars) is released back into the project and is treated as an inflow.

Year	1	2	3	4	5	6	7	8	9
Sales (in Dinars 000)	100	120	150	155	165	175	175	190	0
Cash Balance (in Dinars 000)	20	24	30	31	33	35	35	38	0
Changes in Cash Balance (in Dinars 000)	(20)	(4)	(6)	(1)	(2)	(2)	0	(3)	38

Working Capital

Working capital of a project is generally defined as the project's current assets net of its current liabilities. Current assets typically include cash and marketable securities, accounts receivable, inventories and prepaid expenses. Current liabilities include accounts payable, and any other form of debt that is due within a year or so. The analysis of working capital in this section has two objectives. The first objective is to determine how working capital is accounted for in the cash flow statement, and the second is to determine how working capital requirements for a project are estimated and financed.

Accounting for working capital in the cash flow statement:

The impacts of changes in accounts receivable and in accounts payable on the cash flow statement have been explained and demonstrated when discussing the distinction between sales and receipts, and purchases and expenditures respectively. Changes in cash balances are directly recorded in the cash flow statement as explained above. No other element of the working capital needs to be included in the cash flow statement.

Changes in prepaid expenses should not be included in the cash flow statement. An expenditure item is recorded as a cash outflow once an actual outlay takes place. Whether the expenditure was to pay for past rent or for future rent is irrelevant when constructing a cash flow statement.

Changes in inventories should not be included in the cash flow statement. When a project purchases a certain amount of raw material, inventories will increase. These inventories are financed through a cash outflow and/or an increase in accounts payable. If the inventories have been paid for in cash, then a cash outlay has been recorded in the cash flow statement. If they have been acquired on credit terms, then they will be recorded in the cash flow statement only when they are paid for. The situation is similar when dealing with changes in the inventories of the final product. For example, a decrease in final good inventories implies an increase in sales. This in turn implies an increase in cash receipts or accounts receivable.

Since the components of working capital are developed independently in different plans,[13] it is necessary to check for the overall consistency of working capital. This can be done by comparing the working capital implicitly estimated for the project to industry averages or to similar projects operated by the same department if available.

Estimation of working capital requirements

Ensuring a project's access to sufficient working capital is crucial for the project's

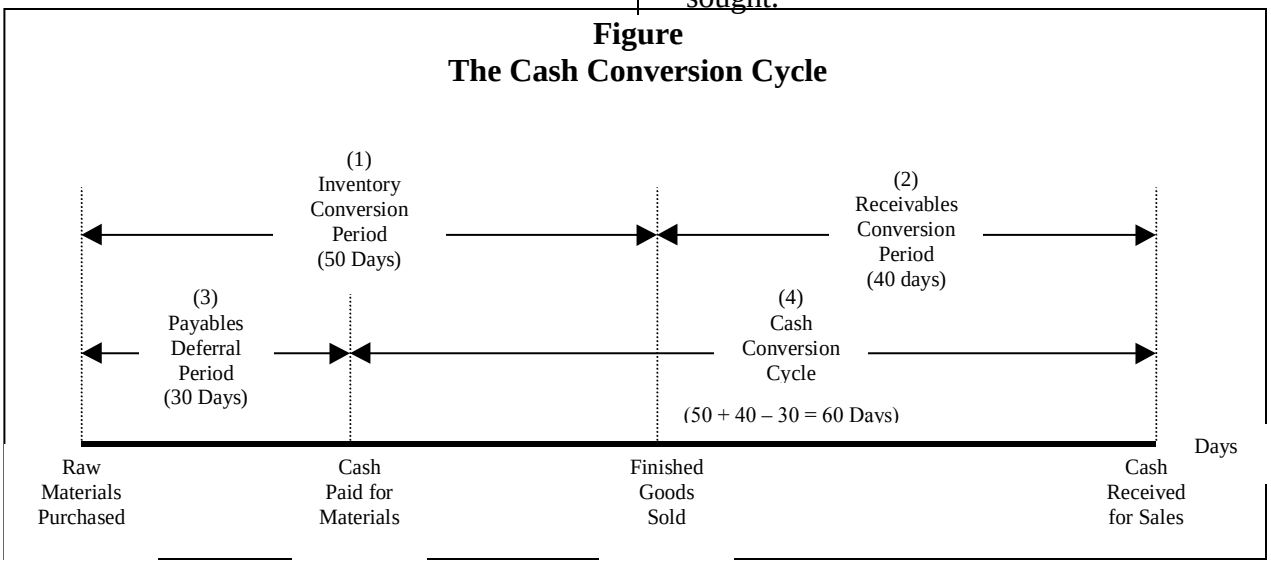
[13] For example, accounts receivable are identified as a percentage of sales in the demand or market plan; accounts payable are estimated as a percentage of purchases in the technical plan; sources of finance are identified in the project's financing plan, etc.

success. When a project starts its operations, it typically incurs expenditures without generating receipts. During this period and till the project starts generating sufficient receipts, it is important to carefully estimate the working capital requirements for a project and determine how they will be met.

Initial working capital requirements for any project depend on the inventory conversion cycle, the receivables conversion cycle and the payables conversion cycle and ultimately on the cash conversion cycle. The inventory cycle is the time period for converting raw materials into final goods; the receivables cycle is the time period for converting accounts receivable into cash; the receivables cycle is the time period for converting accounts payable into cash. The cash cycle is the net outcome of the inventory, receivable and payable cycles.

The figure below provides an illustration of how the working capital financing needs are determined. Suppose a project buys raw material on credit and pays after 30 days. Also suppose that it takes about 50 days to convert raw materials into final products and to sell them. Finally, suppose that it takes 40 days to collect the outstanding accounts receivable. In this case the cash conversion cycle is estimated to be the inventory conversion cycle plus the receivables conversion cycle less the payables conversion cycle, (i.e. 50 days plus 40 days less 30 days = 60 days). Consequently, the project analyst should determine the project's expenditures during the 60 days, and suitable means of financing should be sought.

Figure
The Cash Conversion Cycle



***Source*:** Brigham, Eugene F., Fundamentals of Financial Management, Fifth Edition, The Dryden Press, 1989.

The cash conversion cycle on which the working capital requirements are based is typically much shorter than the unit of time used in the cash flow statement which is generally one year. In other words, a net cash flow for the first year of operations will reflect the total receipts generated during the year net of total expenditures without shedding any light on whether there is enough working capital to get the project started and keep it in progress. It is quite probable that the net cash flow for the first year of operations is indeed positive but not enough working capital has been secured to ensure that the project continues to function smoothly. Consequently, it is necessary that working capital requirements for a project are explicitly worked out, and the appropriate means of financing identified.

Estimation of Income Tax Liability

Income taxes, if expected to be paid by the project, should be included in the cash flow statement. The income tax liability is estimated on the basis of the project's income statement and follows the accounting and tax rules of the country/state. Year by year estimates of cost of goods sold, interest expense, depreciation expense, overheads (if not included in costs of goods sold) are subtracted from the project's revenues to estimate the project's earning before taxes. When estimating the income tax liability, provisions for loss carry forward should be taken into account.

Cessation of Project Operations

When a new project acquires an asset, the entire expenditure on the asset is accounted for in the cash flow statement at the time that the expenditure actually occurs. It is quite possible, however, that the life of the project does not coincide with the life of all its assets, or that the span of the analysis does not extend as far in the future as the project may be expected to operate; for example, railway projects or irrigation systems. If either of the two conditions exists, then the residual value of the asset, i.e. the value of the part of the asset that has not been used should be included in the cash flow statement as an inflow in the year following the cessation of operations.

Consider the following example to illustrate the point. Suppose a project acquires a piece of machinery for one million Dinars in 1998. The machinery has an economic life of 10 years and the expected life of the project is 7 years. The expected market value of the machine at the end of the seventh year is 150,000 Dinars. If we were only to include the expenditure on the machinery (one million Dinars) as an outflow without including the residual value (150,000 Dinars) as an inflow, then we would be penalizing the project.

As a matter of convention, residual values are recorded in the cash flow statement in the year following the cessation of operations. The underlying assumption is that liquidating assets may require a few months. When determining the residual value of the assets at the end of the project, it is preferable to break down all the assets into different categories: land, building, equipment, vehicles, etc. The residual value is taken as the higher of the in-use or liquidation value. The in-use value of the plant is the value of the plant under the assumption that it will continue to operate as an on-going concern. The liquidation value is the value of the assets if all components of the project are sold separately and perhaps even the plant is taken apart and liquidated.

This approach is similar to that taken when estimating the opportunity cost of existing assets. It is, however, more difficult in this case to estimate the in-use and liquidation values since we are dealing with a situation

in the future. General guidelines could be utilized to determine the residual values for these assets based on published *economic* depreciation rates that specify how much of the value of a certain type of the asset is lost as a function of time and/or use. The depreciation rates could be obtained from plant manufacturers; technical journals may contain information on depreciation patterns; also insurance companies (that insure a plant's assets) have some estimates for the plant's rate of economic depreciation.

Land

Land is a special asset in that it generally does not depreciate. The residual value of land recorded in the cash flow statement should be equal to the market value of the land recorded at the beginning of the project, adjusted for the expected inflation rate over the life of the project, unless the project results in some improvement or deterioration to the land. Situations where the project may enhance the value of land should be regarded with caution and should be treated as the exception rather than the rule. In many cases, expectations may indicate that land values are likely to rise faster than the general rate of inflation but the increase is totally unrelated to the project. It is important that project analysts do not include any increase beyond the general rate of inflation in the residual value of the land.

There are two ways in which the cost of land may be included in the cash flow of a project. The first one is straightforward: any appreciation (depreciation) that cannot be attributed to the project is simply ignored and the capital cost is included as investment cost at the beginning of the project and the same value is included as liquidation value at the end of the project life. Thus if land cost is 100,000 Dinars, the investment cost and the residual value will be included as below:

Year	**0**	**1**	**2**	**3**	**4**
Land	-100,000				100,000

In case of inflation, the final value in year 4 should take the inflation into account so that the real value, with respect to year 0, remains unchanged. Final year benefit should be different from Dinars 100,000 only if the land is physically improved or damaged as a result of the project.

An alternative approach is to levy an implicit rental charge as a cost in each time period even when no actual rental is paid. For instance, if a piece of land that is worth 100,000 Dinars is used for a project and it could fetch a market rent of 8% per annum, 8000 Dinars should be included as the annual cost in the cash flow as shown in the following table:

Year	**0**	**1**	**2**	**3**	**4**
Land		-8,000	-8,400	-8,820	-9,261

This would correctly account for the opportunity cost of the piece of land. If there is an annual appreciation (depreciation) in rent, then the appreciated (depreciated) rental value is the annual cost but in this approach the value of land improvement or damage should be included in the final year of the cash flow. With a real appreciation rate of 5% per annum, the rental value would be included in the cash flow table as follows:

Year	**0**	**1**	**2**	**3**	**4**
Land		-8,000	-8,000	-8,000	-8,000

The financial analysis from different points of view

For most projects that are directly undertaken by the government, or involve some government intervention in the form of grants, loans or subsidies, there are several stakeholders that would like to determine the impact of the project on them. Stakeholders are defined broadly to include all those affected by the project. For example, the stakeholders of a project may include the owners, participating banks, any other government department providing loans or grants or collecting taxes, competitors, workers, etc. It is therefore necessary to conduct the analyses from the points of view of the different important stakeholders to ensure the project's sustainability and success. Even one powerful stakeholder who is adversely affected by the project may be able to derail the entire project.

The preceding sections outline the variables that are generally included in the cash flow statement while discussing how they are presented. Some variables will be relevant to the analysis from the point of view of one stakeholder and not from that of another. The most commonly-undertaken financial analyses for government and government-related projects are from the following viewpoints:

i) Point of view of owner,
ii) Point of view of all investors combined (banker's point of view or total investment point of view);
iii) Point of view of the Budget.

These points of view are discussed below focusing on the differences in the variables included in the analyses from the different perspectives.

i) The Owner's Point of View

The owner or sponsor of a project could be a private investor (who may be receiving some form of support from the government or investing under some form of partnership arrangement with the government) or a government department or authority undertaking a project. The appraisal of the project from the owner's perspective includes all receipts and expenditures related to the project in the cash flow statement to determine whether he is made better off or not. Consequently, the owner or sponsor of the project receives the net cash flow after paying off all other involved parties, including the debt holders. The cash flow statement from an owner's point of view includes the disbursement of the loan as an inflow and all subsequent repayments of loan and interest as expenditures. If the project receives any grants or subsidies, these should be included as receipts in the cash flow statement; and if the project pays taxes, these should be included as a cash outflow. If the project sponsor is going to give up an existing source of income to undertake a project, the forgone earnings i.e. the opportunity cost should be included as an expenditure item in the cash flow statement.

ii) The Total Investment (Banker's) Point of View

This point of view examines the returns to the total invested capital. In other words, this analysis disregards any distinctions in the sources of finance. It asks whether the financial receipts generated from the operations of this project are sufficient to cover the investment and operations expenditures, and provide a sufficient return or not. This point of view is also known as the banker's point of view because a bank will be interested in examining the expected receipts and expenditures to determine if the

net cash flows from the total investment are sufficient to cover the loan and interest repayments. The banker typically has first claim to the project's assets and net cash flows, and so the banker's net cash flow is the project's gross receipts net of operating and investment expenditures.[14] The net cash-flows from the total investment (also called the "free cash flows") are therefore important in studying whether these cash flows adequately cover the expected debt repayment schedule. The size, pattern and stability of these cash flows will affect the patterns of debt repayment a project can sustain. For example, if large net cash flows are only expected late in the life of a project, then the debt repayment has to be structured to match that cash-flow pattern.

The only difference between the analysis from the owner's point of view and that from the banker's point of view is financing. Specifically, the cash flow statement from the total investment point of view includes all items included from the owner's perspective except loan and loan repayments.

iii) Budgetary Point of View

The purpose of the analysis from the budgetary point of view is to ensure that the relevant department has enough resources to finance its obligations to the project during both the investment and operational phases. If the government department is the project owner, then the only distinction between the cash flow statement from the owner's point of view and from the budget point of view is that opportunity costs are not taken into account in the latter statement. If, on the other hand, the government's involvement is in the form of providing some cheap credit, subsidies, or grants, then the cash flow statement only reflects these transactions.

Other perspectives

Although the three views outlined above are the most typical points of view considered when conducting the financial analysis, it is important to analyze the impacts of the project on all involved parties. For example, if the project under consideration is likely to have a negative impact on competitors, one should anticipate their resistance and seek feasible solutions. It is thus necessary to estimate the magnitude of the damage to any affected group. Affected groups could include, competitors, suppliers of inputs, downstream processors, etc.

Can This Analysis be Applied to Social Sector Projects?

There are two aspects to this issue. First, is financial analysis relevant for a social sector project? One might argue that it is only the economic analysis that is relevant and if a social sector project is economically sound, its financial analysis is of little consequence. This view is, unfortunately, erroneous. The financial cash flows are crucial for projecting the cash position of the project in the future and determining if and when cash injections from external sources, including the government budget, would be necessary. This may make all the difference between a successful project and a failed project. If the project cannot be implemented due to paucity of funds and lack of advance planning, there is not going to be any

[14] In few cases a subtle difference may exist between the point of view of total invested capital and the banker's point of view. Consider, for example, a government department that is encouraging the construction of low-income housing projects by repaying the interest on the housing loan. An analysis from the total invested capital point of view will not be concerned with the loan at all whether subsidized or not. A banker however, will be definitely more in favor of loaning to a project that receives a government loan subsidy than a similar project that does not receive the subsidy.

economic benefits from the project. Also, it is essential to have an accurate and detailed financial analysis along with an economic analysis in order to conduct the distributional analysis of the project.

Another aspect of this issue is whether it is possible to prepare a detailed financial cash flow, as outlined in the preceding sections, in case of a social sector project. The answer is clearly yes. There is hardly any difference between a social sector project and an industrial project in preparing the cash flow on the cost side. On the benefit side, one has to include whatever revenues are being generated by the project along with other elements like grant/subsidy and liquidation values. In the extreme case when the services are being provided free of cost, the revenues are zero and the financial analysis is able to indicate the yearly requirement of funds for continuing with the project. In case, it is not necessary or possible to quantify financial benefits in monetary terms or when choosing among different technologies for providing the same services, one has to apply the "cost effectiveness" criterion. For doing so, the present values of alternative sets of costs have to be estimated. This is only possible when an elaborate and accurate cash flow has been prepared. It is, therefore, evident that the financial analysis as outlined above is both essential and feasible in case of a social project as well.

Finally, it is important to realize that an analysis that includes the costs and benefits to all involved parties constitutes the first step in the economic analysis of the project. Indeed, this is the starting point for the discussions on the economic analysis presented earlier. A summary of how different financial items should be included in the cash flow statement from different points of view is given in the table below.

Table Summary of Cash Flows Statement from Different Points of Views

	Point of View of Owners	**Point of View of All Investors (Banker's or Total Investment Point of View)**	**Point of View of Budget**	**Point of View of Economy**
	(A)	(B)	(C)	(D)
	Include all receipts in Inflows and all expenditure related to the project in Outflows	= (A) – Loan and loan and interest repayments	Include all subsidies/grants to the project in Outflows and taxes from the project in Inflows	= A – all transfers + externalities
Grant/Subsidy	+	+	-	Not included
Loan	+	Not included	Not included	Not included
Investment costs	-	-	Not included	-
Operating costs	-	-	Not included	-
Loan repayment	-	Not included	Not included	Not included
Interest payment	-	Not Included	Not included	Not included
Foregone earnings	-	-	Not included	-
Taxes	-	-	+	Not included
Positive Externalities	Not included	Not included	Not included	+
Negative Externalities	Not included	Not included	Not included	-

The use of consistent prices in financial appraisal: inflation treatment

When conducting a financial appraisal of a project, it is necessary to develop price and cost projections over the life of the project. These prices are influenced by the forces of demand and supply, which affect relative prices, and by macroeconomic conditions, which determine the general price level or the level of inflation. Accurate forecasts of the future growth in relative prices and in the general price level are beyond the responsibility of the project analyst. However historical trends in growth of prices coupled with recent and expected government policies provide a good basis for making these projections. Variations in these assumptions should be tested using sensitivity and risk analyses to determine whether the project is robust enough to withstand deviations from the assumptions in the base case.

To understand the impact of inflation on the financial viability of a project and how it is incorporated in the analysis, it is necessary to understand the distinction between the different prices and price levels. These are presented in sufficient detail in Annex at the end of this chapter. Two prices however are discussed below due to the important role they can play in the financial analysis of projects. These are the interest rate and the price of foreign exchange.

Interest rate

The most important feature for integrating expectations about the future rate of inflation or expected growth in prices gP^e into the project evaluation is to ensure that such expectations are consistent with the projections of the nominal rate of interest (i). Lenders increase the nominal interest rate on the loans they give to compensate for the anticipated loss in the real value of the loan caused by inflation. As the inflation rate increases, the nominal interest rate increases to ensure that the present value of the interest and principal payments does not fall below the initial value of the loan.

The nominal interest rate i as determined by the financial markets is made up of three major components: a) the real interest rate r which reflects the real time value of money that lenders require in order to be willing to forego consumption or other investment opportunities, b) a risk factor R which measures the compensation lenders demand to cover the possibility of the borrower defaulting on the loan, and c) a factor $(1+r+R)gP^e$ which represents the compensation for the expected loss in purchasing power attributable to inflation. Inflation reduces the future value of both the loan repayments and real interest rate payments. The expected rate of inflation for each period of the loan is expressed as gP^e. Combining these factors, the nominal (market) rate of interest i can be expressed as:

$$i = r + R + (l + r + R)\, gP^e$$

To explain this concept more fully, let us consider the following financial scenarios. When both risk and inflation are zero, a lender would want to recover at least the real time value of money. If the real interest rate r is 5 percent, then the lender would charge at least a 5 percent nominal interest rate. If the lender anticipates that the future rate of inflation gP^e will be 10 percent, then she would want to increase the nominal interest rate charged to the borrower in order to compensate for the loss in purchasing power of the future loan and interest rate payments. Maintaining the assumption that there is no

risk to this loan, we can apply the above equation to determine what nominal interest rate she would need to charge to remain as well off as when the inflation rate was zero.

$$i = r + R + (l + r + R)\, gP^e$$
$$= (0.05) + (0) + (1+ 0.05 + 0)0.1$$
$$= 0.155 \text{ or } 15.55\%$$

Thus, the lender will need to charge a nominal interest rate of at least 15.55 percent to achieve the same level of return as in the scenario with zero inflation.

Generally, the real rate of interest is a fairly constant value because it is primarily determined by the productivity of investment and the desire to consume and save in the economy. Also, the value of the risk premium for the various sectors and investors is typically known. Given the real interest rate, the risk premium and the nominal interest rate, the expected rate of inflation, which is implicit in the nominal interest rate can be estimated by rearranging the above equation as follows:

$$gP^e = (i - r - R)/(1 + r + R)$$

If the rate of inflation is expected to change through time and refinancing of the project's debt is required, then the nominal interest rate paid must be adjusted to be consistent with this new expected rate of inflation. This should have little or no direct effect on the overall economic viability of the project as measured by its NPV; however, it may impose very severe constraints on the liquidity position of the project because of its impact on interest and principal payments if not properly planned for.

Expected (nominal) exchange rate

A key financial variable in any project using or producing tradable goods is the market rate of exchange (E^M) between the Dinar and the relevant foreign currency. This market exchange rate is expressed as the number of units of Dinars required to purchase one unit of foreign exchange (F). The market exchange rate is the current (nominal) price of foreign exchange. The market exchange rate needs to be projected over the life of the project. The market rate between the Dinar and the relevant foreign currency can be expressed at any point in time (t) as:

$$E^M_t = (\text{Dinars}/F)_t$$

The difference between the real price and the nominal price of a good at a given point in time, t_n, lies in the cumulative inflation measured from an *arbitrary* fixed point in time, t_b (base year), to the current point in time, t_n. If we choose the arbitrary point in time to be the same as the current point in time, then there is no difference between the real and nominal prices. For convenience when conducting the financial appraisal of a project, we can select the first year of the project, t_0, as the arbitrary reference point or base year. Consequently, the market exchange rate and the real exchange rate will be equal for that year, t_0.

The cumulative inflation for Iraq over a period of time is given by the domestic price index I^D. If we continue to use the reference year, t_0, as the base year, the domestic price index at any point in time t_n, can be expressed as the cumulative change in the price level from time t_0, to t_n This is given as follows:

$$I^D_{t_n} = \prod_{i=1}^{i=n} (1 + g^{pde}_{t_0+i})$$

Where g^{pde}_i g^{pde}_i is the rate of inflation in the domestic economy.

Similarly the foreign price index at any point in time t_n, using the same reference year, t_0 as the base year, can be expressed as the cumulative change in the price level from time t_0, to t_n This is given as follows:

$$I^F_{t_n} = \prod_{i=1}^{i=n}(1+g^{pfe}_{t_0+i})$$

where g_i^{pfe} is the rate of inflation in the foreign economy. Thus the market exchange rate at time t_n may be expressed in terms of the real exchange rate and price indices as follows:

$$\text{Real Exchange Rate } E^R = \frac{Dinars / I^D_{T_n}}{F / I^F_{t_n}} = \frac{Dinars}{F}\frac{I^F_{t_n}}{I^D_T}$$

$$or E^R = E^M_{t_n}\frac{I^F_{t_n}}{I^D_{t_n}}$$

From this we conclude

$$E^M_{t_n} = E^R * (I^D_{t_n} / I^F_{t_n})$$

or

$$E^M_{t_n} = E^R * \left(\frac{\prod_{i=1}^{i=n}(1+g^{pde}_{t_0+i})}{\prod_{i=1}^{i=n}(1+g^{pfe}_{t_0+i})}\right)$$

The real exchange rate moves through time by the forces of the country's demand and supply for foreign exchange. From the point of view of the project analyst, it is very difficult to predict the movement of the real exchange rate unless it is being artificially maintained at a given level through tariffs or quantitative restrictions on either the supply or demand of foreign exchange. If the rate is not artificially maintained, the analyst can take the real exchange rate as constant throughout the life of the project

The ratio of the two price indices is known as the relative price index. If through time the domestic economy faces a rate of inflation different from that of a foreign trading partner, the relative price index will move over time. If the real exchange rate, E^R, is to remain constant in the presence of inflation, then the change in the relative price index must result in an equal change in the market exchange rate.

Since the future real exchange rate is only likely to be known with some uncertainty, and the market exchange rate might not adjust instantaneously to changes in the rate of inflation, it is more realistic to allow some flexibility in the estimation of the market exchange rate. This is carried out by assuming a range for the distribution of possible exchange rates around an expected mean real exchange rate. To incorporate this aspect we write the above equation as follows:

$$E^M_{t_n} = E^R * (1+k)\left(\frac{\prod_{i=1}^{i=n}(1+g^{pde}_{t_0+i})}{\prod_{i=1}^{i=n}(1+g^{pfe}_{t_0+i})}\right)$$

where K is a random variable with a mean of 0.

Incorporating inflation in the financial analysis

Much of the published literature on project evaluation recommends the exclusion of inflation from the appraisal process.[15] At best, these methods only account for projected changes in relative prices of inputs

15 L. Squire and H.G. van der Tak, Economic Analysis of Projects, (Baltimore: The Johns Hopkins University Press, 1975), p. 38.

and outputs over the life of the investment.[16] However, experience with projects suffering from financial liquidity and solvency problems has demonstrated that inflation can be a critical factor in the success or failure of projects. Correctly designing a project to accommodate both changes in relative prices and changes in the rate of inflation may be crucial for its ultimate survival.

Improper accounting for the impacts of inflation when conducting the financial analysis could have detrimental effects not only on the financial sustainability of a project but also on its economic viability. Assumptions regarding inflation will have a direct impact on the financial analysis of the project and may require adjustments in the operating or investment policies. Since an inadequate treatment of inflation may adversely affect the financial sustainability of the project, ultimately the economic viability of the project may be compromised if inflation is not accounted for properly and the necessary adjustments are not made. The impacts of inflation on the financial analysis of a project are discussed in the annexure.

It is important to realize that the ultimate analysis of the financial cash flows should always be carried out on a statement prepared in real (i.e. net of inflation) Iraqi Dinars. It is not easy to analyze nominal (current) prices or nominal net cash flows as one will be attempting to understand figures that reflect two changes: changes in the real price and changes in the general price level. The correct treatment of inflation requires that preparatory tables be made using nominal prices, and at the very end cash flow statements prepared in nominal prices are deflated to obtain the cash flow statements in real prices.

Outlined below is a method for incorporating inflation into the financial evaluation of a project in a consistent manner. It draws mainly upon the methodology in the Manual on Cost-Benefit Analysis by Jenkins and Harberger.

When preparing the cash flow statement, certain variables such as tax liabilities, cash requirements, interest, and debt repayments need to be estimated in the current prices of the years they are to be incurred in. Other variables making up the cash flow statement are also presented in current prices and initially cash flows in current prices are developed. These cash flows are later deflated and presented in real prices. By constructing the financial analysis in this manner, we ensure that first, all the effects of inflation are consistently reflected in the projected variables and second, all variables are deflated by the projected increase in the general level of prices.

The steps required to carry out the analysis are as follows:

1. Estimate the future changes in the relative prices for each input and output variable.

16 All of the following authors recommend that expectations of inflation of the general price level be ignored in the evaluation of projects:
I.M.D. Little, and J.A. Mirrllees, Project Appraisal and Planning for Development Countries (New York –basic books, 1974)
P. Dasgupta, A. Sen, and S. Marglin, Guidelines for Project Evaluation, (Vienna: UNIDO, 1972).
Arnold C. Harberger, Project Evaluation Collected Papers, (Chicago: Markham, 1973), p. 44.
A more satisfactory treatment of this issue is provided by M. Roemer and Joseph J. Stern, The Appraisal of Development Projects, A Practical Guide to Project Analysis with Case Studies and Solutions, (New York: Praeger Publishers, 1975), pp. 73-74. The authors present a rather mixed treatment of this issue in their case 3 which is not entirely consistent; see also pp. 173-174.

This involves the examination of the present and future demand and supply forces that are expected to prevail in the market for the item. For example, an examination of real prices of many minerals will indicate that they have been dropping a few percentage points a year over the past decade. Real wages, on the other hand tend to increase over time as the economy grows.

2. Estimate or develop a set of assumptions concerning the expected annual changes in inflation over the life of the project.
3. Determine what the nominal rate of interest will likely be over the lifetime of the project given the expected changes in the price level estimated above.
4. Combine the expected change in relative prices with the expected change in the rate of inflation to give the expected change in the nominal price of an item.
5. Multiply the nominal prices for each item by the projections of quantities of inputs and outputs through time to express these variables in the current year's prices of the period in which they are expected to occur.
6. Begin the construction of a cash flow statement using the current (nominal) values for the inputs and outputs.
7. Construct a profit and loss statement for each year of the project's life to determine income tax liabilities with all variables expressed in their nominal values. Depreciation expenses, cost of goods sold, and interest expenses and income tax liabilities are estimated according to the taxation laws of the country. The estimated income tax liabilities are included in the cash flow statement.
8. Estimate cash requirements and any changes in the stock of cash that are reflected in the cash flow statement.
9. Determine financing requirements along with the interest payments and principal repayments and include these items in the cash flow statement. This completes the construction of the projected variables in terms of their current values inclusive of inflation. Now we have a cash flow statement in current prices from the owner's point of view.
10. Deflate all items in the owner's cash flow statement by the inflation price index to arrive at real values for the cash flow statement. Note that loans, interest payments, and loan payments are included at their deflated values in the determination of the cash flow in real prices.
11. Discount the net financial cash flow to the owners of the enterprise by either the real (net of inflation) private opportunity cost of equity financing if it is a private owner or by the target financial rate of return (net of inflation) set by the government if it is a public sector enterprise.
12. Estimate the net financial cash flow from the point of view of the total invested capital. In this case, loans, interest and principal payments do not enter into the calculation of the net financial cash flow.
13. Calculate the net financial cash flow from other points of view if necessary (budget, etc.)

The case studies developed in this manual provides illustrations of the inflation treatment outlined above. The development of pro-forma financial cash flow statements in this way ensures that the impact of inflation on the financial performance of the project is correctly accounted for. At the same time, the final financial analysis is completed with the variables expressed in terms of a constant general price level. In this way, the movement of such variables as receipts, labor costs and material costs can be compared over time without being distorted by changes in the general price level.

When the financial analysis is carried out in terms of real prices, it is essential that the private opportunity costs of capital or the target financial rates of

return used as discount rates be expressed net of any compensation for the expected rate of inflation. In other words, these discount rates must be real and not nominal variables. If a nominal interest rate or target rate of return is used, the result will be a double correction for the expected changes in the general price level. Such practices will greatly distort the conclusions of the analysis concerning the financial viability of the project.

It should be noted that the real financial prices for the input and output variables developed above are used as the basis on which to estimate the economic values for the benefits and costs of the project. Once these economic costs and benefits are estimated, an economic resource flow statement is constructed. The structure of the statement should be similar to that of the financial cash flow statement. Finally, the difference between the two statements is analyzed to determine the distributional impacts of the project.

Chapter VII: Financial Cost of Capital

CHAPTER VII: FINANCIAL COST OF CAPITAL

In this section, we discuss the meaning, interpretation and use of the financial cost of capital in the context of valuing cash flow profiles in project appraisal. Since the financial cost of capital has a major impact on the overall assessment of the investment project from the financial point of view, it is important to have a clear understanding of the concept. Even though the assessment of the project from the economic point of view is the correct criterion for project selection, the financial assessment could determine the long term financial viability and sustainability of the project. In addition, the calculation of the financial cost of capital is complicated by the existence of taxes and debt financing.

Later, we explain how to adjust the financial cost of capital in the presence of taxes and debt financing. Moreover, as discussed below, there are two different points of view in the financial analysis, and for each point of view, there is a corresponding cost of capital.

As mentioned earlier in the previous sections, cash flows that occur at different points in time cannot be aggregated together. A financial cash flow of for example 1000 Iraqi Dinars that occurs in one year from now has less value than a cash flow of 1000 Iraqi Dinars that we can receive immediately (right now). Through the process of discounting, with the appropriate discount rate(s), we "discount" all the future values to the present time, and sum them up to obtain the present value.

The concept of discounting also applies to economic cash flows. To be consistent, we have to discount the (nominal) financial cash flows with the appropriate (nominal) financial discount rate, and the corresponding economic cash flows with the appropriate economic discount rate, or more formally, the economic opportunity cost of capital (EOCK).

Nominal cash flow statement

To take account of the direct and indirect impacts of inflation through various line items in the cash flow statement, we construct the cash flow statement in nominal terms. As shown in the appendix, it is incorrect to construct the cash flow statement in real terms. For example, we pay taxes on annual net incomes that are based on current values and not real values. Thus, when we construct the cash flow statement in nominal terms it means that we have to explicitly model the profile of the expected inflation rate over the life of the project, and the real changes (if any) in the various line items in the cash flow statement relative to the expected inflation rate.

However, with nominal cash flow profiles, it is difficult to assess what is actually happening to the cash flows over time (relative to the expected inflation rate) **without** reference to the expected inflation profile. To have a proper understanding of the movement of the cash flow over time in real terms, we have to analyze the real cash flow, which we can obtain from the nominal cash flow by deflating the nominal cash flow with the expected inflation index.

If there are cash flow items in a foreign currency, then we have to model explicitly the expected nominal foreign exchange rate, which means that we have to model the expected inflation rate in the foreign country, in addition to the expected domestic inflation rate. First, we forecast the

cash flow item in nominal terms in the foreign currency, taking into account the expected inflation rate in the foreign currency. Then we convert the foreign currency cash flow into domestic currency by using the expected nominal foreign exchange rate. In the base case, we assume that the nominal foreign exchange rate follows Purchasing Power Parity (PPP), which means that the nominal foreign exchange rate fully accounts for the expected inflation rates in the domestic and foreign currencies. In the sensitivity and scenario analyses, we can examine the impact of deviations from PPP on the cash flow profile and the desired outcomes of the project.

In terms of valuation, we have to ensure that we properly distinguish the nominal cash flows and the real cash flows. And most importantly, we have to discount the nominal cash flows with the nominal cost of capital, and the corresponding real cash flows with the corresponding real cost of capital. Mixing nominal cash flows with real discount rates or real cash flows with nominal discount rates will lead to incorrect valuations.

Points of view in the financial analysis

In the previous section on the construction of financial cash flow statements from different points of view, we introduced two points of view: the equity holder's point of view and the total investment point of view (TIP). The equity holder's point of view is also known as the owner's point of view.

Briefly, the TIP cash flow represents the cash flow that the project generates **without** taking into account the financing of the project. It represents the free cash flow out of which the combined financiers (debt and equity holders) have to be paid. The TIP cash flow is also known as the cash flow from the Banker's point of view. In other words, it is the cash flow that the Banker, as the financier of the investment project, analyzes to assess the financial viability of the project. As part of the risk assessment, the banker (or debt holder) checks the TIP cash flow to see how well the debt service payments will be covered.

If we combine the TIP cash flow and the cash flow from the debt financing, we obtain the cash flow statement from the equity holder's point of view (or the owner's point of view). The cash flow to the equity holder is the most fundamental cash flow in project appraisal. The equity holder is the owner and the bearer of the residual in the project, and is the ultimate decision maker with respect to the design and attractiveness of a project.

Nominal Weighted Average Cost of Capital (WACC)

In cash flow valuation, we discount the nominal equity cash flow with the expected required nominal return to equity and we discount the nominal TIP cash flow with the appropriate nominal Weighted Average Cost of Capital (WACC). Since the TIP cash flow is the total cash flow that is available for distribution to the debt and equity holders, the nominal WACC, which is the appropriate financial discount rate for the TIP cash flow, reflects the two sources of financing.

Roughly speaking, the WACC is a weighted average of the sources of financing. If there is one debt holder, and one equity holder, then the WACC is a weighted average of the nominal cost of debt and the nominal cost of equity, where the weights are the values of debt and equity, as percentages of the total value.

With the TIP cash flow, we have to be a little careful about the calculation of the taxes. Strictly speaking, the TIP cash flow does not include any impact of debt financing, and thus, it should not include the tax savings that result from the deduction of interest payments in the income statement. In this case, in the construction of the income statement and the estimation of the tax liabilities, we should not include the interest payments as deductions from the earnings. In this case, as explained below, we have to "lower" the Weighted Average Cost of Capital (WACC).

Alternatively, if we do include the tax savings in the derivation of the TIP cash flow, then there is no need to "lower" the WACC. In this case, in the construction of the income statement and estimation of the tax liabilities, we include the interest payments as deductions from the earnings. The tax liabilities are lower than in the previous case.

Case 1: TIP cash flow exclusive of tax savings

If we do not include the tax savings in the derivation of the TIP cash flow, then the expression for the nominal WACC applied to the TIP cash flow is as follows.

$$WACC = [D/(D + E)]\times r_D\times(1 - t) + [E/(D + E)]\times r_E \qquad (1)$$

Where r_D is the expected nominal return on the debt,
D is the market value of the debt,
t is the tax rate,
r_E is the expected nominal required return on equity and
E is the market value of equity.

Since we have not included the tax savings in the cash flow, we have to account for the tax savings by lowering the WACC by applying the term (1 – t) to the cost of debt r_D.

Case 2: TIP cash flow inclusive of tax savings

Alternatively, if we include the tax savings directly in the TIP cash flow, then the expression for the nominal WACC applied to the TIP cash flow is as follows.

$$WACC = [D/(D + E)]\times r_D + [E/(D + E)]\times r_E \qquad (2)$$

Where r_D is the expected nominal return on the debt,
D is the market value of the debt,
r_E is the expected nominal required return on equity and
E is the market value of equity.

In the second case, there is no need to "lower" the WACC with the term (1 – t) because we have included the tax savings in the TIP cash flow.

Here, in the expressions for the nominal WACCs in equations 1 and 2, we have used the nominal cost of debt and the nominal required return to equity. If we use the real cost of debt and the real required return to equity, we can obtain the corresponding real WACCs for the TIP cash flow.

Consistency check for the two financial points of view

There is a simple consistency check on the valuation of the equity and TIP cash flows. The total value of a project equals the sum of the value of the debt and the equity.

Total value = Value of debt + Value of Equity (3)

In terms of NPV, the NPV of the TIP cash flow (inclusive of the tax savings), discounted at the WACC equals the sum of the NPV of the cash flow to the debt holder, discounted at the cost of debt d and the NPV of the cash flow to the equity holder, discounted at the required return to equity e.

$$NPV^{TIP}_{WACC} = NPV^{CFD}_{d} + NPV^{CFE}_{e} \quad (4)$$

It is reasonable to assume that the NPV of the nominal cash flow to the debt holder, discounted at the nominal cost of debt, is zero, where the nominal cost of debt fully accounts for the expected inflation over the life of the project. This means that the debt holder obtains the expected real return on the debt, and does not gain or lose from financing the project.

$$NPV^{CFD}_{d} = 0 \quad (5)$$

With this assumption, it is easy to see that the NPV of the TIP cash flow, discounted by the WACC must equal the NPV of the cash flow to equity, discounted by the required nominal return to equity.

$$NPV^{TIP}_{WACC} = NPV^{CFE}_{e} \quad (6)$$

Numerical example

We illustrate these ideas with a simple numerical example. For convenience, we have specified easy numbers for the calculations. Consider a project that requires an investment of 1000 Iraqi Dinars for the purchase of machinery at the end of year 0. The economic life of the machinery is five years, and the economic depreciation of the machinery equals the depreciation allowance for accounting purposes.

The project generates annual revenues of 450 Iraqi Dinars. The expected inflation rate is zero, the tax rate is 30%, and the required return on equity is 30%.

Below, we show the depreciation schedule for the machinery and the income statement without any debt financing.

Table 1: Depreciation schedule for the machinery

Depreciation allowance	200.0						
	Year	0	1	2	3	4	5
Beginning balance			1,000.0	800.0	600.0	400.0	200.0
Depreciation allowance			200.0	200.0	200.0	200.0	200.0
Ending balance		1,000.0	800.0	600.0	400.0	200.0	0.0

The annual depreciation allowance is 200 Iraqi Dinars per annum and at the end of year 5, the liquidation value of the machinery is zero.

Table 2: Income statement without debt financing (in Iraqi Dinars.)

	Year	0	1	2	3	4	5
Revenues			450.0	450.0	450.0	450.0	450.0
Depreciation			200.0	200.0	200.0	200.0	200.0
EBIT			250.0	250.0	250.0	250.0	250.0
Interest payments			0.0	0.0	0.0	0.0	0.0
EBT			250.0	250.0	250.0	250.0	250.0
Taxes			75.0	75.0	75.0	75.0	75.0
Net Income			175.0	175.0	175.0	175.0	175.0

The annual EBT (Earnings before taxes) is Iraqi Dinars 250, the annual tax payment is Iraqi Dinars 75, based on a tax rate of 30%, and the annual net income is Iraqi Dinars 175. From the income statement, we can easily obtain the TIP cash flow.

Table 3: Total Investment Point of View (TIP) cash flow

	Year	0	1	2	3	4	5
Revenues			450.0	450.0	450.0	450.0	450.0
Investment		1,000.0					
Taxes			75.0	75.0	75.0	75.0	75.0
TIP Cash Flow		-1,000.0	375.0	375.0	375.0	375.0	375.0

The TIP cash flow consists of the annual revenues, less the initial investment in year 0, and less the annual tax payments. The annual revenues, net of taxes, are Iraqi Dinars 375.

Next, we introduce debt financing. The annual cost of debt is 10%. At the end of year 0, the value of the debt is Iraqi Dinars 600, which will be repaid in five equal annual installments. Since the cost of the machinery is Iraqi Dinars 1,000, and the debt financing is Iraqi Dinars 600, the remaining Iraqi Dinars 400 will be financed by the equity holder.

The loan schedule is shown below. Using the PMT function, we find that the annual equal payment for the loan is Iraqi Dinar 158.3, and as expected, at the end of year 5, the loan balance is zero.

Table 4: Loan schedule

	Year	0	1	2	3	4	5
Beginning balance			600.0	501.7	393.6	274.7	143.9
Interest accrued			60.0	50.2	39.4	27.5	14.4
Payment			158.3	158.3	158.3	158.3	158.3
Ending balance		600.0	501.7	393.6	274.7	143.9	0.0

Since the interest payments are tax deductible, we show a new income statement with debt financing.

Table 5: Income statement with debt financing

	Year	0	1	2	3	4	5
Revenues			450.00	450.00	450.00	450.00	450.00
Depreciation			200.00	200.00	200.00	200.00	200.00
EBIT			250.00	250.00	250.00	250.00	250.00
Interest payments			60.00	50.17	39.36	27.47	14.39
EBT			190.00	199.83	210.64	222.53	235.61
Taxes			57.00	59.95	63.19	66.76	70.68
Net Income			133.00	139.88	147.45	155.77	164.93

As expected, in each year, the taxes in the income statement with debt financing (Table 5) are lower than the taxes in the income statement without debt financing (Table 2).

Table 6: Cash flow statement, equity point of view

	Year	0	1	2	3	4	5
Revenues			450.0	450.0	450.0	450.0	450.0
Investment		1,000.0					
Taxes			57.0	59.9	63.2	66.8	70.7
Cash flow to debt		600.0	-158.3	-158.3	-158.3	-158.3	-158.3
Equity Cash Flow		-400.0	234.7	231.8	228.5	225.0	221.0
PV 30.00 %		160.02					

Next, we show the cash statement from the equity point of view. The revenues and initial investment are the same as in Table 3. With the interest deduction, the taxes are lower than in Table 3. Also, now we add the debt financing. At the end of year 0, the loan is a cash inflow, and the repayments in years 1 to 5 are cash outflows. With respect to the end of year 0, the net present value (NPV) of the equity cash flow, discounted at the required return to equity of 30%, is 160.02.

Annex I: Conducting Financial Analysis in Nominal Prices

The effects of inflation on a project's financial condition include:
(1) Direct impacts from changes in investment financing, cash balances, accounts receivable, accounts payable, and nominal interest rates,
(2) Tax impacts including interest expenses, depreciation and inventories, and
(3) The impact on the market exchange rate.

Inflation alters the amount and timing of the financial gains and losses of the various parties involved in a project including the owner(s), the lender(s) and the government. Correctly accounting for those changes is necessary to determine how the overall project and each of the interested parties are affected by different levels of inflation.

1. Direct Effects

(i) Investment Financing

When estimating the amount of financing an investment project requires, it is important to distinguish between two types of cost increases. First, there are cost over-runs which are caused by incorrect estimates of the quantities of materials required or changes in the real prices of those materials. Second, there is cost escalation which is attributable to the general price level inflation. The "escalation" of costs that stems from pure price inflation should be recognized as normal and, if possible, should be anticipated and included in the project appraisal. If the project requires a loan or equity financing for future outlays, it should be recognized that the amount of financing needed will be affected by the amount of price inflation that takes place during the time of construction. Cost increases attributable to inflation are not overruns of real costs; therefore, additional borrowing that simply reflects the rise in the general level of prices should be planned for. If this condition is not adequately planned for at the appraisal stage, the project may experience a liquidity crisis or insolvency due to inadequate financing.

Table A-1 demonstrates the effects of inflation on investment financing. All values are given in Iraqi Dinars. The project will be built during the first two time periods, operate for following four, and then be liquidated in the final time period. The total cost of construction will be capitalized at the end of the second period to determine the amount to be depreciated. Loans are obtained for 50% of the investment in fixed assets. Loan financing will have a nominal interest rate of 5 percent per period if there is no inflation, and interest will begin accruing during the construction period. The loan principal will be repaid at the end of the last operating year of the project, period 5. The remainder of the financing requirements is covered by the owners' equity.

In this project an investment of 5000 Iraqi Dinars is made in fixed assets in year 0, and if there is no inflation, a further 5000 Iraqi Dinars is made in year 1. If there is 25% inflation a year, the initial year's investment does not change, however the nominal investment undertaken in year 1 increases to 6,250 Iraqi Dinars.

TABLE A-1
Project XYZ Financing

Period	0	1	2	3	4	5	6
Inflation = 0%							
1. Price Index	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2. Investment Outlays	5000	5000	0	0	0	0	0
Inflation = 25%							
3. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
4. Investment Outlays	5000	6250	0	0	0	0	0
5. Impact on Financing Requirements]	0	1250	0	0	0	0	0

The presence of inflation increases the nominal amount of the investment financing required by 1,250 Iraqi Dinars even when there are no real increases in material needs or costs. For a 25 percent inflation rate, total nominal project costs increased from 10,000 to 11,250 Iraqi Dinars, or by 12.5 percent. The increased investment cost has three effects. First, it increases the interest costs to the project. Second, it increases the nominal amount of the loan principal (50% of nominal investment costs) which must be repaid by the project. Finally, it results in a larger nominal depreciable allowance that will be deductible from future taxes. These effects have both positive and negative cash flow impacts which are discussed below.

(ii) Desired Cash Balances

Cash balances are held by a project to facilitate transactions. An enterprise needs to maintain an amount of cash on hand that is related to the value of sales and purchases they carry out. If the demand for cash balances is a function only of the level of sales and sales remain constant with no inflation, then after initially setting aside the desired amount of operating cash, no further investments in the cash balances would be required. However, when there is inflation, the nominal values of the sales, receipts, and the cost of the goods purchased go up even if the quantities of goods bought and sold remain the same. In such a situation, the project either will have to increase its cash balances in order to conduct operations or substitute more physical resources (e.g. labor, telephone calls, etc.) to carry out these transactions.

The effects of inflation on cash balances can be demonstrated using a simple comparison of two cases. The first case shows the cash situation for a project operating in an environment where there is no inflation. Sales will be 2,000 for each period from 2 through 5, and the desired cash balance is equal to 10 percent of the nominal value of sales. Hence, given the absence of inflation, after the initial 200 is placed in the cash account, there is no need to increase that balance. The present value of the cost of holding cash by the project is Iraqi Dinars -41 (Table A-2, line 6).

TABLE A-2
Project XYZ Cash Balance

Period	0	1	2	3	4	5	6
Inflation = 0%; Desired cash balance = 10% of sales							
1. Price Index	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2. Sales	0	0	2000	2000	2000	2000	0
3. Desired Cash Balance	0	0	200	200	200	200	0
4. Change in Cash Balance	0	0	(200)	0	0	0	200
5. Real cash flow impact [4/1]	0	0	(200)	0	0	0	200
6. Present value of holding cash @ 7%= (41)							

However, if the inflation rate increases to 25 percent per period, the cash balances must be increased to keep abreast of the increasing nominal value of sales. We assume for the purpose of this example that the number of units sold remains the same but their nominal value increases by 25% a year due to inflation. As a result, the desired stock of cash balances will increase, requiring an additional investment of cash in the project during each period if the desired level is to be maintained (Table A-3, row 4). After deflating these costs for inflation and discounting them, we find that the present value of the cost of the cash needed to run the business has increased substantially.

With zero inflation in Table A-2, the present value of the cost of holding real cash balances was -41. However, when the inflation rate is 25 percent, the present value of the cost of maintaining the same level of real cash balances will equal to -159 as shown in Table A-3, line 6. This 288 percent increase in the cost of holding cash demonstrates clearly that in an inflationary environment the need to continuously add to the stock of cash balances will add to the real costs of the project. Hence, project evaluators should incorporate a number of inflation projections in order to determine the sensitivity of total costs to the impact of inflation on the cost of holding the desired level of real cash balances.

TABLE A-3
Cash Balance with 25% Inflation

Period	0	1	2	3	4	5	6
Inflation = 25%; Desired cash balance = 10% of sales							
1. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
2. Sales	0	0	3125	3906	4883	6104	0
3. Desired Cash Balance	0	0	313	391	488	610	0
4. Change in Cash Balance	0	0	(313)	(78)	(98)	(122)	610
5. Real cash flow impact [4/1]	0	0	(200)	(40)	(40)	(40)	160
6. Present value of holding cash @ 7% = (159)							

(iii) Accounts Receivable

Accounts receivable arise from credit sales. When goods are sold and delivered but the enterprise is still awaiting payment, the value of this sale is added to accounts receivable. Such credit sales are part of the normal process of conducting business. However, in the presence of inflation, the real value of the amounts that are owed to the seller decrease the longer they are left unpaid. This creates an additional financial problem for the management of the enterprise, because they must be concerned not only with the normal risk of default but also with the fact that the receivables are falling in real value the longer they are left unpaid.

Table A-4 demonstrates the interaction between inflation and accounts receivable and the impact that interaction has on cash receipts. As the inflation rate rises, the value of sales increases due to the higher prices of the goods, even when the number of units sold remains unchanged. This generally leads to an increase in the amount of accounts receivable. In this case, it is assumed that receivables will be equal to 20% of sales.

TABLE A-4
Accounts Receivable

Period	0	1	2	3	4	5	6
Inflation = 0%							
1. Sales	0	0	2000	2000	2000	2000	0
2. Accounts Receivable	0	0	400	400	400	400	0
3. Change in A/R	0	0	(400)	0	0	0	400
4. Real Receipts [1+3]	0	0	1600	2000	2000	2000	400
Inflation = 25%							
5. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
6. Sales	0	0	3125	3906	4883	6104	0
7. Accounts Receivable	0	0	625	781	977	1221	0
8. Change in A/R	0	0	(625)	(156)	(195)	(244)	1221
9. Nominal Receipts [6+8]	0	0	2500	3750	4688	5859	1221
10. Real Receipts [9/5]	0	0	1600	1921	1921	1921	321
11. Change in Real Receipts [10-4]	0	0	(79)	(79)	(79)	(79)	
12. Present value of the change in real receipts @ 7% = (233)							

In spite of the fact that the nominal value of sales increases each period when there is 25 percent inflation, Table A-4 demonstrates that the present value of the real receipts for this project decreases by 233 due to the higher rate of inflation. This is because inflation causes the real value of outstanding trade credit to fall. When this situation arises, businesses selling goods or services (the project in this case) will attempt to reduce the length of the terms they give for trade credit, while businesses purchasing the product will have an additional incentive to delay payment. Therefore, it is important to include in a project evaluation the interaction of inflation and accounts receivable to determine how the real receipts of the business are affected by inflation.

(iv) Accounts' Payable

Accounts payable represent the amount of money owed by a business to others for goods or services already purchased and delivered. When there is inflation, the buyer with the accounts payable benefits from having an outstanding balance because the real value of the obligation is falling during the period of time prior to the payment. This is simply the other side of the impact of inflation on accounts receivable because one enterprise's accounts receivable is another's accounts payable.

Table A-5 shows how inflation affects a project's financial situation when accounts payable are equal to 25% of annual purchases. Once again, we see that inflation increases the nominal value of purchases which leads to greater accounts payable as well.

The increased rate of inflation results in a net decrease of 155 in the present value of real expenditures. As shown in line 6, inflation increases the nominal value of purchases, and creates a corresponding increase in nominal accounts payable in line 7. When converted to real expenditures, the buyer (the project in this case) benefits from the effects of inflation on accounts payable and will have a lower overall level of expenditure, as shown in Table A-5, row 11. This gives the buyer an incentive to extend the terms of the accounts payable to benefit from their falling real value. Hence, in the presence of inflation, the longer the outstanding accounts payable are held before being paid, the greater the benefit accruing to the buyer.

TABLE A-5
Accounts Payable

Period	0	1	2	3	4	5	6
Inflation = 0%							
1. Purchases of Inputs	0	1000	1000	1000	1000	0	0
2. Accounts Payable	0	250	250	250	250	0	0
3. Change in A/P	0	(250)	0	0	0	250	0
4. Real Expenditures [1+3]	0	750	1000	1000	1000	250	0
Inflation = 25%							
5. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
6. Purchases	0	1250	1563	1953	2441	0	0
7. Accounts Payable	0	313	391	488	610	0	
8. Change in A/P	0	(313)	(78)	(98)	(122)	610	0
9. Nominal expenditures [6+8]	0	937	1485	1855	2319	610	0
10. Real Expenditures [9/5]	0	750	951	951	951	201	0
11. Change in real expenditures [10-4]		0	(49)	(49)	(49)	(49)	0
12. Present value of the change in real expenditures @ 7 %=(155)							

(v) Nominal Interest Rates

Another way inflation alters the real net financial condition of a project is through its impact on nominal interest rates. Lenders increase the nominal interest rate on the loans they give to compensate for the anticipated loss of the real value of the loan caused by inflation. As the inflation rate increases, the nominal interest rate will be increased to ensure that the present value of the interest and principal payments will not fall below the initial value of the loan. This results in increased interest payments in the short term that compensate for the decreasing value of the loan principal over the long term.

The nominal interest rate *i* as determined by the financial markets is made up of three major components: (1) there is a factor *r* which reflects the real time value of money that lenders require in order to be willing to forego consumption or other investment opportunities, (2) a risk factor *R* which measures the compensation the lenders demand to cover the possibility of the borrower defaulting on the loan, and (3) a factor $(1+r+R)gP^e$ which is compensation for the expected loss in purchasing power attributable to inflation. Inflation reduces the future value of both the loan repayments and real interest rate payments. The expected rate of inflation for each period of the loan is expressed as gP^e. Combining these factors, the nominal (market) rate of interest *i* can be expressed as:

$$i = r + R + (l + r + R)\times gP^e$$

For example, if the real interest rate (r) is 5 percent, the risk premium and inflation are zero, then the lender would charge at least 5 percent nominal interest. If the lender anticipates that the future rate of inflation

(gP^e) will be 25 percent, however, then she would want to increase the nominal interest rate charged to the borrower in order to compensate for the loss in purchasing power of the future loan and interest rate payments. Maintaining the assumption that there is no risk to this loan, we can apply the following equation to determine what nominal interest rate she would need to charge to remain as well off as when there was no inflation.

$$i = r + R + (l + r + R) \times gP^e$$
$$= (0.05) + (0) + (1+ 0.05 + 0)0.25$$
$$= 0.3125$$

Thus, the lender will need to charge a nominal interest rate of at least 31.25 percent to achieve the same level of return as in the zero inflation scenario.

For the project we are analyzing in this chapter, fixed assets investments are financed 50% by debt and 50% equity. All other investments such as initial supplies are financed 100% by equity. In Tables A7.6 and A7.7, the loan schedule for the debt portion of the financing is calculated under the 0% and the 25% inflation rate scenarios.

TABLE A-6
Nominal Interest Rate of 5 percent

Inflation = 0%

Period	0	1	2	3	4	5	6
1.Loan Principal	2500	2500	0	0	0	0	0
2. Interest	0	(125)	(250)	(250)	(250)	(250)	0
3. Loan Repayment	0	0	0	0	0	(5000)	0
4. Real Cash Flow [1+2+3]	2500	2375	(250)	(250)	(250)	(5250)	0
5. PV @ 5%= 0							

From Table A-1, we know that the higher rate of inflation will increase both the nominal investment required and the nominal interest rate. The higher initial capital requirement must then be repaid at the higher nominal interest rate as shown in Table A-7.

TABLE A-7
Nominal Interest Rate of 31.25 percent

Inflation = 25%

Period	0	1	2	3	4	5	6
1. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
2. Loan Principal	2500	3125	0	0	0	0	0
3. Interest	0	(781.3)	(1757.8)	(1757.8)	(175.8)	(1757.8)	0
4. Loan Repayment	0	0	0	0	0	(5625)	
5. Nominal Cash Flow [2+3+4]	2500	2343.7	(1757.8)	(1757.8)	(1757.8)	(7382.8)	0
6. Real Cash Flow [5/1]	2500	1875.0	(1126.8)	(901.4)	(720.4)	(2420.6)	0

Comparing Tables A-6 and A-7, we find that the present values of both loans are the same. This demonstrates that a loan with a 31.25 percent interest rate when inflation is 25 percent has the same present value as a loan with an interest rate of 5% when inflation is zero. The crucial differences are between the timing and amount of repayment. The higher nominal interest rate of 31.25 and higher inflation forces the project to repay its loans faster than if the inflation rate and nominal interest rates were lower. Table A-8 shows the difference between the project's cash flow in the two scenarios.

TABLE A-8
Comparison of Real Cash Flows

Period	0	1	2	3	4	5	6
1. 31.25% interest with 25% inflation	2500	1875	(1126.8)	(901.4)	(720.4)	(2420.6)	0
2. 5% interest with 0% inflation	2500	2375	(250.0)	(250.0)	(250.0)	(5250)	0
3. Difference in Real Cash Flow [1-2]	0	(500)	(876.8)	(651.4)	(470.4)	2829.4	0

In real terms, the higher nominal interest rate increases the cash outflows (or reduces the net cash inflows) of the project during periods 1-4 but decreases the value of the principal that is due at the end of the project by 282.94. This is important to the evaluation of the sustainability of a project because the higher outflows during the early years of the repayment period could cause liquidity problems for the project if it is not generating sufficient cash inflows.

Effect on tax related factors

Inflation has three impacts on the tax liabilities of a project. First, the higher interest payments shown in the previous section increase the amount of tax deduction that can be taken for that interest. Second, inflation reduces the value of the depreciation allowances taken for earlier investments in the project. Finally, the method used to account for inventory has an effect on the nominal earnings that are used to determine the taxable income. These three effects offset each other somewhat; however, in most cases where the impact of inflation has been studied empirically, the overall effect of inflation has been to increase tax payments significantly.

(i) Interest Deduction

Inflation can alter the financial feasibility of a project through the impact that increased nominal interest payments have on the income tax liabilities of the enterprise. In most countries, interest payments are deductible from income for the calculation of taxes, while principal repayments are not deductible. When the expected rate of inflation increases, nominal interest rates rise in order to compensate the lender for the loss in the purchasing power of the principal outstanding and future interest payments. Table A-9 shows how inflation, through the way it converts some of the real value of the principal repayments into interest payments, causes tax payments to fall. The higher nominal interest payments are deductible from taxable income, hence they serve to reduce the amount of taxes which the project would otherwise be required to pay.

TABLE A-9
Interest Expense

Income Tax Rate = 30%

Period	0	1	2	3	4	5	6
Inflation = 0%; Nominal Interest = 5%							
1. Interest Expense	0	(125)	(250)	(250)	(250)	(250)	0
2. Real Tax Savings [row 1*.3]	0	37.5	75	75	75	75	0
Inflation = 25%; Nominal Interest = 31%							
3. Interest Expense	0	(781.3)	(1758)	(1758)	(1758)	(1758)	0
4. Tax Savings [row 3*0.3]	0	234	527	527	527	527	0
5. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
6. Real Tax Savings [4/5]	0	187.2	337.8	270.3	215.9	172.8	0
7. Change in Tax Savings [6-2]	0	149.7	262.8	195.3	140.9	97.8	0
8. PV of increased tax savings @ 7% = 706							

(ii) Depreciation Allowance

Another factor affected by inflation is the real value of the depreciation allowances for capital goods which are deductible for income tax purposes. Most countries base the deductions for depreciation expense (capital cost allowances) on the original nominal cost of the depreciable assets. If inflation increases, then the relative value of this deduction will fall causing the real amount of income tax liabilities to increase. In Table A-10, we see that a 25 percent rate of inflation causes the tax savings from depreciation expense deductions to fall by 1090. This is equal to approximately 10 percent of the real value of the fixed assets being depreciated.

TABLE A-10
Project XYZ: Depreciation Allowance

Straight Line Depreciation over 4 periods; Income Tax Rate = 30%

Period	0	1	2	3	4	5	6
Inflation = 0%; Depreciable Investment = 10000							
1. Depreciation	0	0	2500	2500	2500	2500	0
2. Real Tax Savings [row 1*0.3]	0	0	750	750	750	750	0
Inflation = 25%; Nominal Depreciable Investment = 11250							
3. Depreciation	0	0	2812.5	2812.5	2812.5	2812.5	0
4. Tax Savings [row 3*0.3]	0	0	844	844	844	844	0
5. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
6. Real Tax Savings [4/5]	0	0	541	433	346	276	0
7. Change in Real Tax Savings [6-2]	0	(209)	(317)	(404)	(474)	0	

8. PV of change in real Tax Savings @ 7% = (1090)

(iii) Inventory Accounting

(a) First-In-First-Out (FIFO)

Further tax implications of inflation are experienced by enterprises which must account for inventories of inputs and outputs. In many countries to determine the amount of taxable profit enterprises are required to value inventories in their accounts on a first-in-first-out basis (FIFO). This means that the price of the oldest inventories (first in) is the value which is used to determine the cost of the goods sold (COGS). The difference between the COGS and the sale price is the taxable revenue from the project.

TABLE A-11
Inventory and Cost of Goods Sold - FIFO

Income Tax Rate = 30%

Period	0	1	2	3	4	5	6
Inflation = 0%							
1. Sales	0	0	2000	2000	2000	2000	0
2. Purchase of Inputs	0	1000	1000	1000	1000	0	0
3. COGS	0	0	1000	1000	1000	1000	
4. Measured Profits [1 - 3]	0	0	1000	1000	1000	1000	0
5. Real Tax Liability [4*0.3]	0	0	300	300	300	300	0
Inflation = 25%							
6. Sales	0	0	3125	3906	4883	6104	0
7. Purchase of Inputs	0	1250	1563	1953	2441	0	0
8. COGS	0	0	1250	1563	1953	2441	0
9. Measured Profits [6 - 8]	0	0	1875	2343	2930	3663	0
10. Nominal Tax Liability	0	0	563	703	879	1099	0
11. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
12. Real Tax Liability [10/11]	0	0	361	361	361	361	0
13. Change in tax liability [12-5]	0	0	61	61	61	61	0

13. PV of change in tax liability @ 7% = 193

Taxable revenue generally increases by the rate of inflation because sale prices are affected immediately by the rate of inflation, while the costs of goods sold from inventories are valued using prices of a previous period when the nominal prices were presumably lower. For example, if the project has a one year inventory of final goods at the beginning of the year and the inflation rate for that year is 25 percent, then nominal cost prices of the goods sold will be 25 percent lower than their selling prices one year later, even if no profit margin is added. The result is that the measured profits are artificially inflated which increases the tax burden in both nominal and real terms.[17] From Table A-11, lines 1-14, we see that by increasing the rate of inflation from 0 to 25 percent, the present value of real tax payments increases by 193.

(b) Last-In-First-Out (LIFO)

Another method for accounting for the cost of goods sold is known as last-in-first-out (LIFO). As the name implies, the most recent goods purchased (last in) are used to measure the cost of goods sold (first out), and the prices of the project inputs are generally increasing at the same rate of inflation as the outputs sold. During the production cycle of a project, this is a benefit because the profits are not increased artificially by the presence of inflation. It also means that taxes will be lower as a result. However, LIFO has a negative aspect as well because as the activity winds down, or the level of inventories is reduced due to business conditions, the lower prices of the goods that were purchased in earlier years are now used to calculate the cost of goods sold, resulting in inflated profits and increased taxes as shown in Table A-12, row 13 - period 5.

The LIFO system for accounting for cost of goods sold allowed tax liabilities to remain unaltered until period 5. As the project winds down, the prices used to calculate the COGS for that period are now from period one. Hence, with 25 percent inflation profits in period five will be greatly inflated, causing the tax burden to increase in real terms by 177 (line 13 - period 5) over the no inflation scenario.

Comparing the effects of inflation on the tax liability in the FIFO and LIFO accounting systems, we see that in both cases, inflation increased the taxes. With FIFO and 25 percent inflation the present value of the tax liability increased by 193 (Table A-11), and with LIFO, the present value increased by 126 (Table A-12).

[17]. This occurs because, in a period of rapid inflation, the historical cost of inventories now being used in production will be substantially less than the current replacement cost of these items. If taxable income is calculated using the historical cost of the inventory items, the real cost of goods will be underestimated and taxable income will be overestimated. Therefore, real income tax liabilities will be greater than they would be if no inflation had existed.

TABLE A-12
Inventory and Cost of goods Sold - LIFO

Income Tax Rate = 30%

Period	0	1	2	3	4	5	6
Inflation = 0%							
1. Sales	0	0	2000	2000	2000	2000	0
2. Purchase of Inputs	0	1000	1000	1000	1000	0	0
3. COGS	0	0	1000	1000	1000	1000	
4. Measured Profits [1-3]	0	0	1000	1000	1000	1000	0
5. Real Tax Liability [4*0.3]	0	0	300	300	300	300	0
Inflation = 25%							
6. Sales	0	0	3125	3906	4883	6104	0
7. Purchase of Inputs	0	1250	1563	1953	2441	0	0
8. COGS	0	0	1563	1953	2441	1250	0
9. Measured Profits [6-8]	0	0	1562	1953	2441	4854	0
10. Nominal Tax Liability	0	0	469	586	732	1456	0
11. Price Index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
12. Real Tax Liability [10/11]	0	0	300	300	300	477	0
13. Change in tax liability [12-5]	0	0	0	0	0	177	0

14. PV of change in taxes due @ 7% =126

In addition to the cost difference, the timing of the tax burden is substantially different. Using FIFO, inflation increased the taxes in each period, whereas using LIFO resulted in no increase in taxes in the production period but in a larger tax liability in the last sales period. LIFO defers the increased tax burden attributable to inflation until a period when there is a need to lower the level of inventories. As the lower priced inventories are drawn into the cost of goods sold, the difference between inflated sales values and older prices generates larger profits and increases the tax liability. Using LIFO could increase the overall risk associated with the project in a high inflation environment if the reason for the enterprise wanting to lower the level of inventories was financial stress or business slow down. In such a situation, the increased tax liability is concentrated in a few periods when the project is already facing problems, while with FIFO the increased tax liability is spread out over each operating period. Hence, when doing the appraisal it is important to consider the type of accounting rules used for determining the cost of goods sold to assess how inflation might affect both the timing and quantity of the tax liabilities to be paid by the project.

Annex II

Foundations of Risk Analysis

Introduction

To conduct risk analysis in project appraisal, it is necessary to understand some basic concepts in probability and statistics. In the table of parameters for the construction of the model for project appraisal, we list the expected values for the variables, with the clear understanding that there is uncertainty about these values. The variability and uncertainty in the parameters means that there will also be variability in the desired outcomes, such as the NPV of the project from different points of view.

How do we model and understand the uncertainty in the variables and the desired outcomes? We use the theory of probability and statistics.

Consider a simple numerical example. Suppose we believe that the output price can take on only three possible discrete values: \$10, \$12 and \$14. This is clearly an unrealistic example because in practice there will be a whole range of values for the output price rather than just three values. Nevertheless, for getting a grasp of the basic ideas, the simple example is a good place.

Next we ask the question: what is the likelihood that each of these prices will occur? We have to assign probabilities for each of the prices. Since the three prices are the only possibilities, the sum of the probabilities for the three prices must equal one.

Table 1: Values and probabilities for the output price, with equal probabilities

Output price	Probability
10	1/3
12	1/3
14	1/3

For simplicity, we can assume that all the prices are equally likely, in which case, the probability for each price is one-third. With the knowledge of the values and probabilities for the prices, we can calculate the expected value of the output price. Let P_i represent the ith price, and let Prob(P_i) represent the probability of the ith price. Then the expected value equals the sum of each price times its corresponding probability. For this example, the expected value of the price is \$12.

Expected value of the output price

$= P_1 \times \text{Prob}(P_1) + P_2 \times \text{Prob}(P_2) + P_3 \times \text{Prob}(P_3)$

$= 10 \times 1/3 + 12 \times 1/3 + 14 \times 1/3 =$ **12.00** (1)

Measure of central tendency

The expected value is a measure of the central tendency of the output price. Other common names for the expected value are "average value" or "mean value". In the above example, the discrete probability distribution for the output price is symmetric. The lower price of $10 and the higher price of $14 are equidistant from the mean value of $12.

Next, consider a different set of output prices as follows. Again, we assume that all of the three values for the output price are equally likely. What is the expected value in this case?

Table 2: Values and probabilities for the output price, with equal probabilities

Output price	Probability
8	1/3
12	1/3
16	1/3

In this case, the expected value of the price is again $12.

Expected value of the output price
$= P_1 \times Prob(P_1) + P_2 \times Prob(P_2) + P_3 \times Prob(P_3)$

$= 8 \times 1/3 + 12 \times 1/3 + 16 \times 1/3 =$ **12.00** (2)

Let X_i be the ith price. Suppose there are N discrete prices and each price is equally likely. Then the probability for each price is 1/N. The general formula for the expected value is as follows.

Expected value $= \Sigma X_i/N \quad \forall\ i = 1$ to N (3)

Measure of dispersion

How about the variability in the price? How would we compare the variability of the set of output prices in Table 2 with the variability of the set of output prices in Table 1? To compare the variability, we need to define a measure for the variability. The variance is common measure of variability or dispersion of the output price. How do we calculate the variance?

We use the following steps. First, we calculate the deviation of each of the prices from the average price. This is known as the "deviation from the mean". Second, we square each of the deviations from the mean. Third, we take the average of all of the deviations from the mean.

Table 3: Calculation of the variance of the output price in Table 1

	Price	Price - AvgP	(Price - AvgP) Sq
	10	-2.0	4.0
	12	0.0	0.0
	14	2.0	4.0
# of observations	3	3	3
Average	12		

For the price of $10, the deviation of this price from the expected price is -2; for the price of $12, the deviation is zero, and for the price of $14 the deviation is +2. Notice that if we were to use the sum of the deviations from the mean as a measure of the dispersion, we would obtain a value of zero. Clearly in this case, the dispersion of the price is not zero, and thus it would not make sense to use the sum of the deviations from the mean as a measure of dispersion. Instead, we square each of the deviations from the mean, and take the average.

$$\text{Variance} = ((10 - 12)^2 + (12 - 12)^2 + (14 - 12)^2)/3 = \mathbf{2.67} \quad (4.1)$$

$$\text{Standard deviation} = \mathbf{1.63} \quad (4.2)$$

Since we squared the deviations from the mean to obtain the variance, the unit for the variance is the square of the price. Thus, we define the standard deviation as the square root of the variance, and use the standard deviation as a measure of the dispersion. Thus, the standard deviation for the output prices in Table 1 is 1.63.

Using the same procedure, we calculate the variance of the output price in Table 2. In this case, the variance is and the standard deviation is 3.27.

Table 4: Calculation of the variance of the output price in Table 2

	Price	Price - AvgP	(Price - AvgP) Sq
	8	-4.0	16.0
	12	0.0	0.0
	16	4.0	16.0
# of observations	3.0	3	3
Average	12.0		

$$\text{Variance} = ((8 - 12)^2 + (12 - 12)^2 + (16 - 12)^2)/3 = \mathbf{10.67} \quad (5.1)$$

$$\text{Standard deviation} = \mathbf{3.27} \quad (5.2)$$

In this case, the standard deviation is 3.27. And as expected, the dispersion of the output price in Table 2 in greater than the dispersion of the output price in Table 1.

Let X_i be the ith price. Suppose there are N discrete prices and each price is equally likely. Then the probability for each price is 1/N. The general formula for the variance is as follows.

$$\text{Variance} = \Sigma (X_i - \mu)^2/N \quad \forall\ i = 1 \text{ to } N \quad (6)$$

Example with unequal probabilities

It is not necessary that all of the values for the prices are equally likely. For example, it may be the case that the probability for the price equal to $12 is 50%, and the probability for each of the other prices is 25%.

In this case, again the expected value of the price is $12.
Expected value of the output price
$= P_1 \times Prob(P_1) + P_2 \times Prob(P_2) + P_3 \times Prob(P_3)$
$= 10 \times 25\% + 12 \times 50\% + 14 \times 25\% =$ **12.00** (7)

Table 5: Values and probabilities for the output price, with unequal probabilities

Output price	Probability
10	25%
12	50%
14	25%

Continuous probability distributions

In this section, we discuss three common continuous probability distributions: the uniform distribution, the triangular distribution and the normal (Gaussian) distribution.

Uniform distribution

The uniform distribution is the easiest to understand. Suppose we believe that the output price is uniformly distributed between $10 and $30. Compared to the previous discrete examples with three values for the output price, what is the meaning of the uniform distribution? We briefly discuss some of the properties of the uniform distribution. First, the output price can take on any value between the two endpoints of $10 and $30; and there is zero probability that the price is less than $10, and also zero probability that the price is more than $30. Even though in reality the output price could occur outside of the two endpoints, in some cases, the uniform probability distribution may be a reasonable specification.

Second, with a continuous probability distribution, there is zero probability of a single price occurring. Thus it makes no sense to mention a single-valued price. We must mention a continuous range of values. For example, we cannot ask the question: what is the probability that the price is $10? We have to ask the question: what is the probability that the price is less than $11? In other words, what is the probability that the price is between $10 and $11?

The graph of this uniform probability distribution is shown below.
For a continuous probability distribution, the total area under the graph for the probability distribution must equal one.

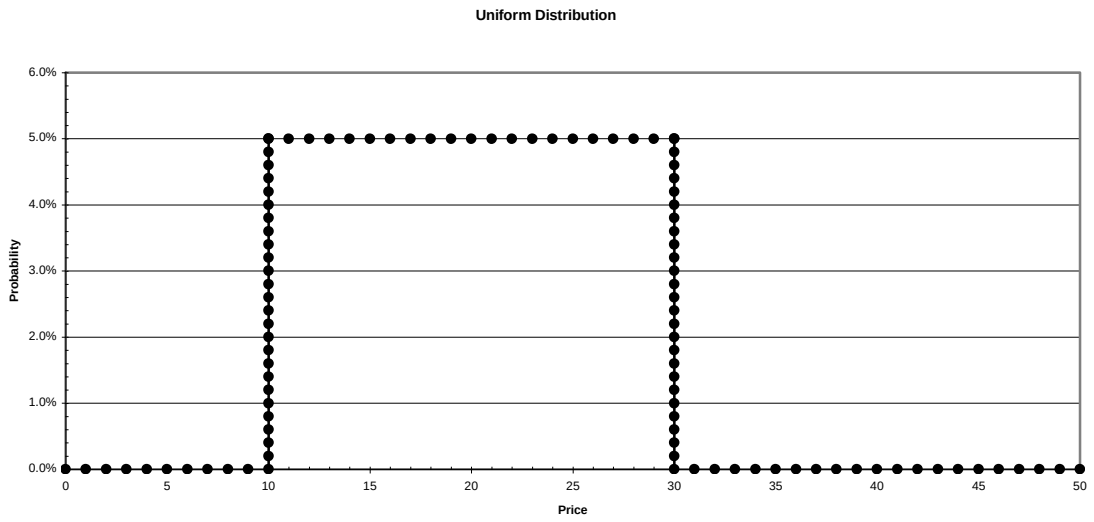
Based on this property, what should be the height of the graph?
(Maximum value – minimum value)×height = 1 (8)

Thus the height must be 5% since the difference between the maximum and minimum value is 20.

Now we can ask some questions about the uniform probability distribution.

What is the probability that the output price will be between $15 and $20?

Figure 1: Graph of uniform probability distribution



To calculate the answer, we have to the area of the rectangle between the two endpoints and the graph of the uniform probability distribution. The probability is 25% that the output price is between $15 and $20.

Probability = 5%×(20 – 15) = **25.0%**
(9)

What is the probability that the output price will be between $25 and $28?
The probability is 15% that the output price is between $25 and $28.

Probability = 5%×(28 – 25) = **15.0%**
(10)

What is the probability that the output price will be between $21 and $28?
The probability is 35% that the output price is between $21 and $28.

Probability = 5%×(28 – 21) = **35.0%**
(11)

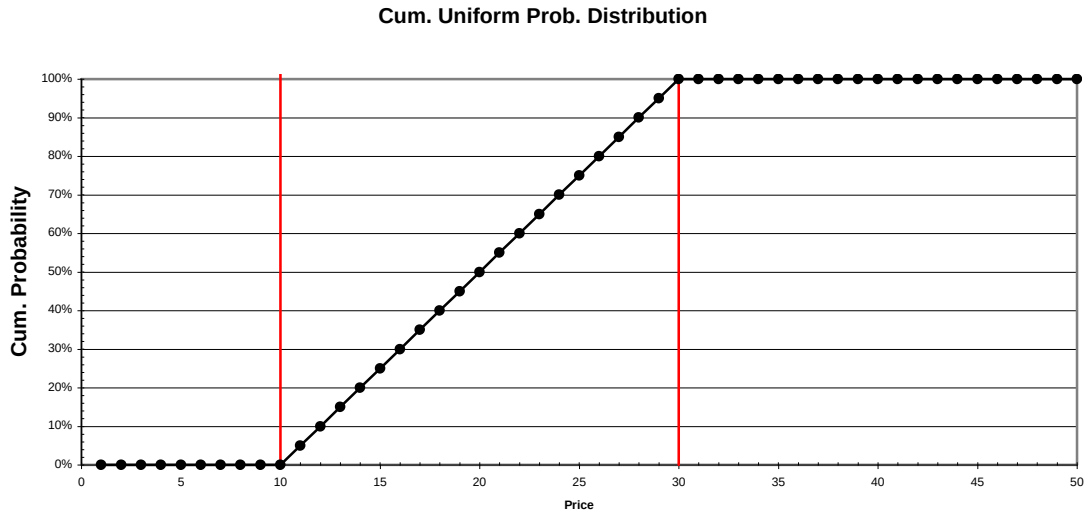
For the uniform probability distribution, it is particularly easy because the graph of the uniform probability distribution is a horizontal line. For other probability distributions, such as the triangular or normal, it is not as easy.

Cumulative uniform probability distribution

For the uniform probability distribution, we can easily graph the cumulative probability distribution. In this case, the cumulative probability distribution is a straight line with a slope of one-twentieth.

To find the cumulative probability from the lower endpoint to any desired value for the price, select the desired value for the price and go up to the graph for the cumulative probability distribution and read off the cumulative probability from the vertical axis

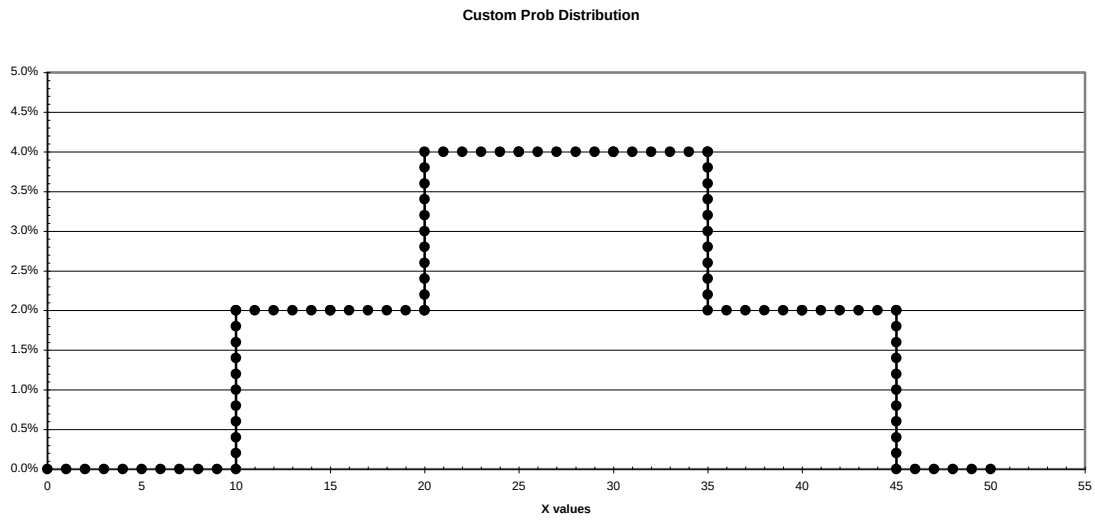
Figure 2: Cumulative uniform probability distribution]



Custom (or step) distribution

Another common probability is the step distribution.

Graph 3: Insert graph for custom step distribution



In this case, we specify the probability for different ranges of value. Consider the following (symmetric) step distribution for the output price. Between $10 and $20, the output price is uniformly distributed, the cumulative probability is 20%, and the height of the graph is 2%.

Table 6: Cumulative probabilities for step distributions

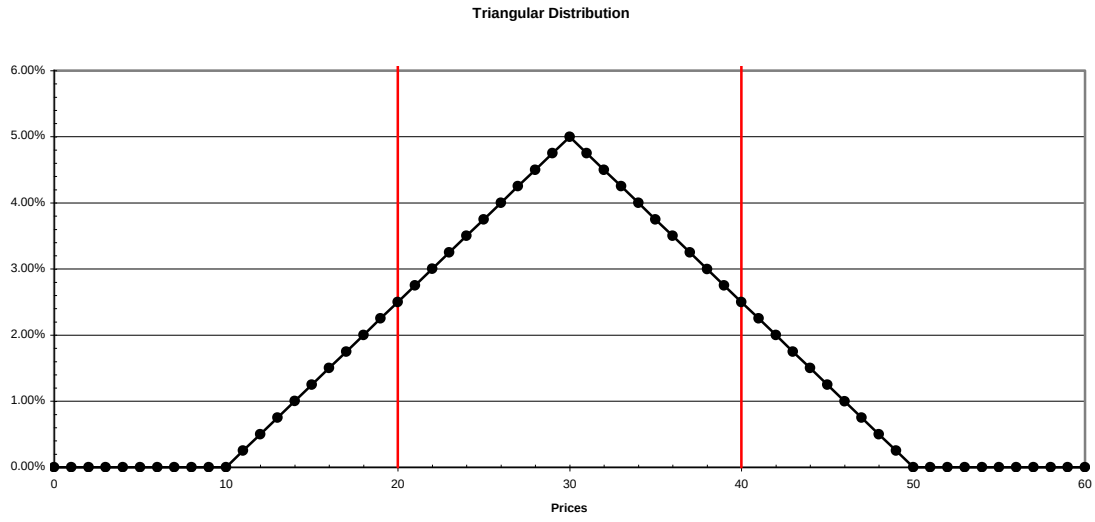
Output price	Cumulative Probability
10	
20	20%
35	60%
45	20%

Between $20 and $35, the output price is uniformly distributed, the cumulative probability is 60%, and the height of the graph is 4%. Between $35 and $45, the output price is uniformly distributed, the cumulative probability is 20%, and the height of the graph is 2%.

Triangular distribution

In some case the triangular distribution may be suitable. The triangular distribution may be symmetric or non-symmetric. For a symmetric triangular distribution, the peak is the midpoint of the maximum and minimum values.

Figure 4: Insert graph for triangular distribution



The two endpoints of the triangle determine the range of values for the price.

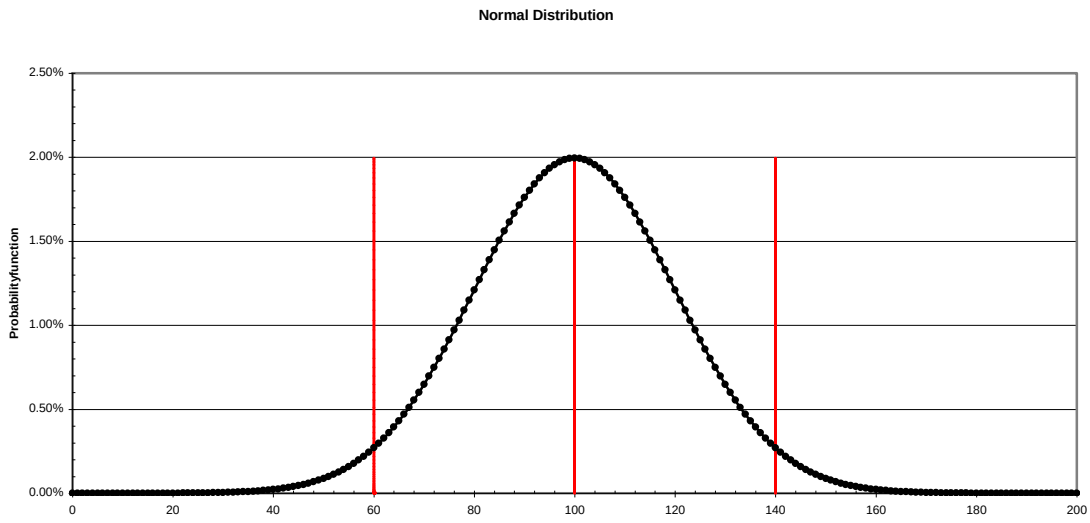
Normal (Gaussian) distribution

The normal distribution is the familiar bell-shaped probability distribution. It is one of the most useful and widely used probability distribution. We present and discuss some well-known properties of the normal distribution. The normal distribution is fully characterized by the mean and standard deviation. In other words, if we know the mean and standard deviation of any normal distribution, we can calculate the probability for any range of values. Suppose we assume that the unit price of the output X follows a normal distribution with a mean value of \$100 and a standard deviation of \$20. We write this as follows. The symbol ~ stands for "distributed as" and N stands for normal distribution. The first parameter in parenthesis is the mean value and the second parameter is the variance.

$$X \sim N(100,20^2)$$

We must note that the normal distribution does not fully fit the price variable.

Figure 5: Graph for the normal distribution



For example, the normal distribution ranges from minus infinity to plus infinity. Clearly, the price cannot take negative values and there is some upper limit to the price. Nevertheless, for practical purposes, the normal distribution is convenient to use and appropriate.

With the normal distribution there are some well-known rules about the probability between given ranges of values.

Rule One Sigma

We can ask the question: what is the probability that the output price is **within** one standard deviation of the mean? In other words, what is the probability that the price X is between 80, which is one standard deviation (or one sigma) below the mean and 120, which is one standard deviation above the mean? The answer, for any normal distribution, is 68%.

$$\text{Prob}(\mu - \sigma \le X \le \mu + \sigma) = \text{Prob}(100 - 20 \le X \le 100 + 20)$$
$$= \text{Prob}(80 \le X \le 120) = 68\% \quad (12)$$

Rule Two Sigma

What about the probability that the price is **within** two standard deviations of the mean? In other words, what is the probability that the price is between 60, which is two standard deviations (or two sigmas) below the mean and 120, which is two standard deviations above the mean? The answer, for any normal distribution, is 95%.

$$\text{Prob}(\mu - 2\sigma \le X \le \mu + 2\sigma) = \text{Prob}(100 - 2\times 20 \le X \le 100 + 2\times 20)$$
$$= \text{Prob}(60 \le X \le 140) = 95\% \quad (13)$$

Rule Three Sigma

What about the probability that the price is **within** three standard deviations of the mean? For any normal distribution, the probability is 99% that the price is within three standard deviations of the mean.

$$\text{Prob}(\mu - 3\sigma \le X \le \mu + 3\sigma) = \text{Prob}(100 - 3\times 20 \le X \le 100 + 3\times 20)$$
$$= \text{Prob}(40 \le X \le 160) = 99\% \quad (14)$$

Based on these three rules about one, two and three sigma, we can answer the following additional questions for a normal distribution.

What is the probability that the output price X is above $120? In other words, what is the probability that the output price X is one standard deviation **above** the mean?

$$\text{Prob}(X \ge \mu + \sigma) = \text{Prob}(X \ge 100 + 20)$$
$$= \text{Prob}(X \ge 120) = ?$$

From the rule one sigma, we know the following.

$$\text{Prob}(\mu - \sigma \le X \le \mu + \sigma) = \text{Prob}(100 - 20 \le X \le 100 + 20)$$
$$= \text{Prob}(80 \le X \le 120) = 68\% \quad (15)$$

The probability that the output price is more than 2 standard deviations from the mean (in absolute value terms) is 32%. In other words, the combined probability that X is either one standard deviation below the mean or one standard deviation above the mean is 32%.

$$\text{Prob}(X \le \mu - \sigma) \text{ or } \text{Prob}(X \ge \mu + \sigma) = 100\% - 68\% = \mathbf{32.0\%} \quad (16)$$

Since the normal probability distribution is symmetric, it means that the probability of the lower tail equals the probability of the

upper tail of the probability distribution. Thus, the probability that the output price is one standard deviation above the mean is 16%.

Prob ($X \geq 120$) = 32%/2 =**16.0%**
(17)

What is the probability that the output price X is below $140? In other words, what is the probability that the output price X is two standard deviations **below** the mean?

Prob ($X \leq \mu - 2\sigma$) = Prob ($X \leq 100 - 40$) = Prob ($X \leq 60$) = ?

From the rule two sigma, we know the following.

Prob ($\mu - 2\sigma \leq X \leq \mu + 2\sigma$) = Prob ($100 - 2\times20 \leq X \leq 100 + 2\times20$)
= Prob ($60 \leq X \leq 140$) = 95%
(18)

The probability that the output price is more than 2 standard deviations from the mean (in absolute value terms) is 95%. In other words, the combined probability that X is either two standard deviations below the mean or two standard deviations above the mean is 5%.

Prob ($X \leq \mu - 2\sigma$) or Prob ($X \geq \mu + 2\sigma$) = 100% - 95% = **5.0%**(19)

Since the normal probability distribution is symmetric, it means that the probability of the lower tail equals the probability of the upper tail of the probability distribution. Thus, the probability that the output price is one standard deviation above the mean is 2.5%.

Prob ($X \leq 60$) = 5%/2 = **2.5%**
(20)

What is the probability that the output price X is between $80 and $140? In other words, what is the probability that the output price X is between one standard deviation below the mean and two standard deviations **above** the mean?

Prob ($\mu - \sigma \leq X \leq \mu + 2\sigma$) = Prob ($100 - 20 \leq X \leq 100 + 2\times20$)
= Prob ($80 \leq X \leq 140$) = ?

To answer this question, we can rewrite it as the sum of two probabilities, namely the probability between one standard deviation below the mean and the mean plus the probability between the mean and two standard deviations above the mean.

Prob ($\mu - \sigma \leq X \leq \mu + 2\sigma$) = Prob ($\mu - \sigma \leq X \leq \mu$)
+ Prob ($\mu \leq X \leq \mu + 2\sigma$)
= Prob ($80 \leq X \leq 100$)
+ Prob ($100 \leq X \leq 140$)
(21)

The probability between one standard deviation below the mean and the mean is 34%.

Prob ($\mu - \sigma \leq X \leq \mu$) = Prob ($80 \leq X \leq 100$) = 34% (22)

The probability between the mean and two standard deviations above the mean is 2.5%.

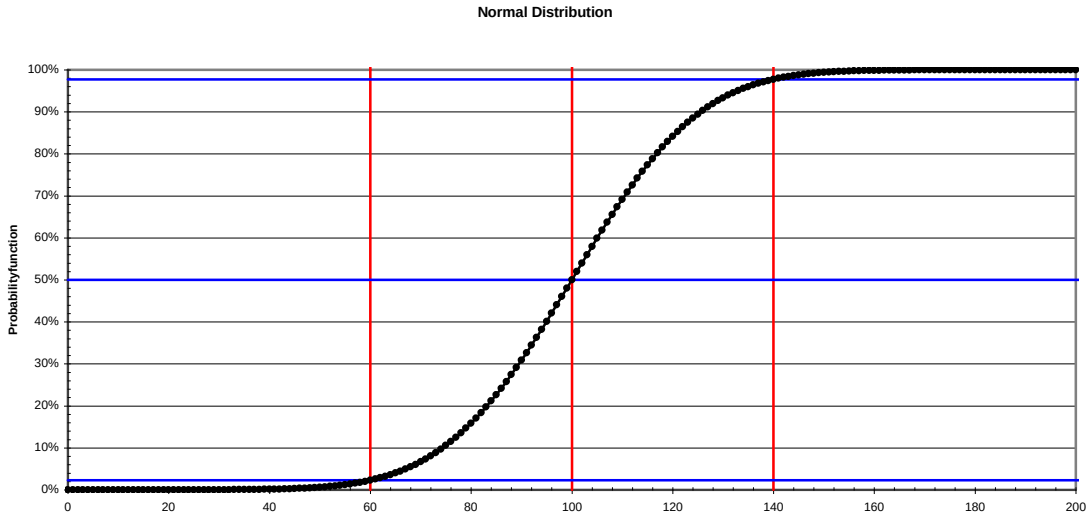
Prob ($\mu \leq X \leq \mu + 2\sigma$) = Prob ($100 \leq X \leq 140$) = 50% - 2.5%
= 47.5%
(23)
Thus, the combined probability is 81.5%.

Prob ($\mu - \sigma \leq X \leq \mu + 2\sigma$) = 34% + 47.5% = **81.5%** (24)

Cumulative normal probability distribution

Next, we discuss the cumulative normal probability distribution. The vertical axis of the cumulative distribution shows the cumulative probability.

Figure 6: Graph for the cumulative normal distribution



To find the cumulative probability distribution, we go from the desired horizontal value to the graph and read the cumulative probability off the vertical axis.

The cumulative probability distribution from Monte Carlo Simulation

The risk analysis with the Monte Carlo Simulation generates the cumulative probability distribution for the desired outcomes of the project, such as the NPVs from different points of view. The cumulative probability distribution is useful for decision making. From the cumulative probability distribution, we can easily read off the probability that the NPV of the project will be negative.

Correlations between variables

Next, we discuss correlations between variables. Consider two variables, the price of the output X and the quantity of output Y. Let μ_X be the expected value for X, and let μ_Y be the expected value for Y. It is reasonable to assume that there is a negative relationship between these two variables. The measure of the strength of the relationship between two variables X and Y is the covariance. The formula for the covariance is as follows.

$$\text{Covariance} = \Sigma (X_i - \mu_X)(Y_i - \mu_Y)/N \quad \forall\ i = 1 \text{ to } N \qquad (25)$$

We illustrate the use of this formula with a simple numerical example.

Table 5: Calculation of the covariance of the output price and quantity

	Price X	Quantity Y	(X - AvgX) Sq	(Y - AvgY) Sq	Product
	10	24	-2.0	4.0	-8.0
	12	20	0.0	0.0	0.0
	14	16	2.0	-4.0	-8.0
# of observations	3.0	3.0			
Average	12.0	20.0			
Std Dev	1.633	3.266			

First, we calculate the deviation of the X values from the expected X value, and the deviation of the Y values from the expected Y value. Second, we multiply the deviation of the ith X value and the corresponding deviation for the ith Y value. Third, we take the average.

Covariance = (-2×4 + 0×0 + 2×-4)/3 = **-2.67** (26)

We cannot use the covariance measure to compare the strength of the relationships between pairs of variables because the units for the covariance are the product of the units for the two variables.

We define the correlation coefficient as follows. The correlation coefficient equals the covariance divided by the product of the standard deviation of X and the standard deviation of Y.

Correl(X,Y) = Covariance(X,Y)/($\sigma_X \times \sigma_Y$)

= **-2.67**/(1.633×3.266) = **-0.50**(27)

In this case, the correlation coefficient between X and Y is -0.50. By definition, if the two variables are perfectly positively correlated, the maximum value for the correlation coefficient is +1; if the two variables are perfectly negatively correlated, the minimum value for the correlation coefficient is -1.

If the two variables are perfectly positively correlated, it means that the values of X equal the values of Y. The formula for the covariance in the numerator is identical to the formula for the variance, and the product in the denominator also equals the variance. Thus the maximum possible value is +1. If the two variables are perfectly negatively correlated, it means that the values of X equal the negative of the values of Y. And thus, the minimum possible value is -1.

Annex III

Principles of Risk Analysis and Management

In this section, we present the principles of risk analysis and management. Risk analysis and management are integral components of the project appraisal framework. In the previous discussion on the construction of the financial and economic cash flow statements, we postponed the issue of uncertainty and simply specified the expected values for the key variables in the table of parameters. Based on these expected values, in the subsequent tables of the project appraisal, we entered formulas that were linked to the key variables in the table of parameters. It is extremely important that the formulas are properly linked. If the formulas for the desired outcomes, such as the NPVs from the different points of view, are not properly linked, then it would not be possible to conduct risk analysis.

In the risk analysis, we introduce uncertainty explicitly into the project appraisal and analyze the risk profiles of the nominal cash flows from different points of view. After we have a good understanding of the risk profiles of the cash flows from different points of view, we move forward and examine the issue of risk diversification and management. The risk analysis enables us to identify and focus on the key variables on which we may wish to acquire better information.

In the risk analysis, first, we identify, analyze and interpret the expected variability in the desired project outcomes from alternative points of view. We discuss sensitivity analysis, scenario analysis and Monte Carlo Simulation (MCS).

Second, we discuss the sources of risk and the issue of risk diversification, using some simple variance relationships.

Third, we examine how we can redesign and reorganize the project to allocate, and if necessary reallocate, the risk in a more efficient manner.

Risk analysis

The motivation and necessity for risk analysis is straight-forward. As mentioned earlier, there is uncertainty in the values of the key variables that we list in the table of parameters for the project appraisal. The variability in the key variables affects the desired outcomes, such as the Net Present Value (NPV) of the project from different points of view. Thus we have to examine how changes in the values of the key variables impact the desired outcomes. With the results of this analysis, we can examine issues in risk management and the design of contracts for risk allocation.

Since the nominal cash flow profiles for a project extend over many years, there is uncertainty both at a given point in time and across time. For example, in a given year, there may be variability in the unit price of the output. Also, we recognize that the unit price of the output may change over time, in which case we have to model the correlations, if any, between prices over time.

There are alternative methods for risk analysis, ranging from the simple to the complex.

1. Sensitivity analysis

2. Scenario analysis
3. Monte Carlo Simulation (MCS)

Below, we describe each of the three methods.

Sensitivity analysis

In the table of parameters for a project appraisal, we list the expected values for the key variables, with the recognition that there is uncertainty about the values for the variables. In the sensitivity analysis, we examine how changes in the values of one of these variables, holding constant the values of all of the variables, affect the NPV of the net cash flow. Sensitivity analysis is also known as "what-if" analysis.

In EXCEL, it is easy to create simple one-way and two-way tables (sensitivity tables) that show how changes in the value of a certain variable impact on the NPV of the project, *ceteris paribus* (holding constant the values of all the other variables). The generation of the one-way tables requires that the cells for the desired outcomes are properly linked to the variables in the table of parameters. It is very important to keep in mind the *ceteris paribus* condition. As we discuss later, we must recognize that in reality many variables are changing simultaneously.

Also, with sensitivity analysis, we can conduct break-even analysis for each of the key variables. For example, we can determine the output price that will cause the NPV of the project to switch from positive to negative. The break-even values for each of the key variables will provide a qualitative assessment of the extent to which the project is responsive to changes in the values of the key variables.

Furthermore, sensitivity analysis is a powerful diagnostic tool for assessing the construction of the overall financial models. For many variables, we know the direction of the impact of changes in the value of the variable on the desired outcomes. For example, generally speaking, an increase in the expected inflation rate should have a negative impact on the NPV of the project, taking into account all the direct and indirect effects of inflation. If the sensitivity analysis reveals that an increase in the expected inflation rate leads to an increase in the NPV of the project, it is most likely that there is an error in the modeling. If there is no error, then the analyst should be able to identify the reason(s) why inflation is creating value.

We illustrate the ideas and concepts of sensitivity analysis with the following simple numerical example. Suppose a project sells 10 units each year, and at the end of year 0, the unit price is Iraqi Dinars. 20, which increases at the expected inflation rate of 5%. The real discount rate is 10%, and with an expected inflation rate of 5%, the nominal discount rate is 15.5%.

First we construct the inflation index, and obtain the nominal price profile by multiplying the initial unit price in year 0 with the expected inflation index.

Table 1: Inflation index and nominal price profile

	Year	0	1	2	3	4	5
Inflation index		1.000	1.050	1.103	1.158	1.216	1.276
Nominal unit price			21.00	22.05	23.15	24.31	25.53

Thus, in year 5, the nominal unit price is Iraqi Dinars. 25.53. In any year, the revenues equal the nominal price for that year times the quantity of output.

Table 2: Annual revenues and accounts receivable

	Year	0	1	2	3	4	5
Annual revenues			210.00	220.50	231.53	243.10	255.26
Accounts receivable (AR)			42.0	44.1	46.3	48.6	0.0
Change in AR			-42.0	-2.1	-2.2	-2.3	48.6

The annual accounts receivable in years 1 to 4, as a percentage of the revenues, is 20%. In year 5, the accounts receivable is zero.

Table 3: Nominal cash flow statement

	Year	0	1	2	3	4	5
Annual revenues			210.00	220.50	231.53	243.10	255.26
Change in AR			-42.0	-2.1	-2.2	-2.3	48.6
Net cash flow			168.0	218.4	229.3	240.8	303.9
PV 15.50 %		593.30					

In any year, the net cash flow equals the sum of the annual revenues and the change in accounts receivable. With these assumptions, the present value (PV) of the net cash flow for the project with respect to the end of year 0, at a discount rate of 15.5%, is $593.3. Thus, the PV of the net cash flow is $593.3, if all of the values that we have specified for the variables occur simultaneously, namely the output is 10 units, the initial output price in year 0 is $20, the accounts receivable is 20%, and the expected inflation rate is 5%. As noted earlier, we know that there is variability in the values of these four variables, and it is extremely unlikely that the specified values for the four variables will occur simultaneously to give the NPV of $593.3. Thus, the single value estimate of the NPV of the project is not very useful for decision-making. The variability in the values of the variables means that there will be variability in the NPV of the project, depending on the values that occur for the variables. This suggests that we need to model the variability in the desired outcomes.

In this numerical example we conduct sensitivity analysis with the following variables on the PV of the net cash flow: the quantity of output, the initial output price in year 0, the accounts receivable and the expected inflation rate.

Impact of changes in the quantity of output on the PV of the net cash flow

Table 4: Sensitivity analysis of the quantity of output on the PV of the net cash flow

		PV
Quantity of output	10	593.3
	11	652.6
	12	712.0
	13	771.3
	14	830.6
	15	890.0

Table 4 shows the sensitivity analysis of the quantity of output on the PV of the net cash flow. In other words, it shows the relationship between the quantity of output and the PV of the net cash flow, with different values for the quantity of output.

At an output of 10 units, the PV of the net cash flow is Iraqi Dinar 593.3. If the output were to increase from 10 units to 15 units, the PV would increase from Iraqi Dinar 593.3 to Iraqi Dinar 890. Based on this one-way table, we can analyze the impact of changes in the units of the output on the PV of the net cash flow.

Impact of changes in the initial output price on the PV of the net cash flow

Table 5 shows the sensitivity analysis of the initial output price in year 0 on the PV of the net cash flow. In other words, it shows the relationship between the initial output price and the PV of the net cash flow, with different values for the initial output price.

At an initial output price of Iraqi Dinar 20, the PV of the net cash flow is Iraqi Dinars. 593.3. If the initial output price in year 0 is Iraqi Dinars. 16 rather than Iraqi Dinars 20, then the PV of the net cash flow would be Iraqi Dinars. 474.6. Based on this one-way table, we can analyze the impact of initial output price in year 0 on the PV of the net cash flow.

Table 5: Sensitivity analysis of the initial output price on the PV of the net cash flow

		PV
Initial output price	16	474.6
Year 0	17	504.3
	18	534.0
	19	563.6
	20	593.3
	21	623.0

Impact of changes in the accounts receivable on the PV of the net cash flow

Table 6 shows the sensitivity analysis of the accounts receivable, as a percentage of the annual revenues, on the PV of the net cash flow.

Table 6: Sensitivity analysis of the accounts receivable on the PV of the net cash flow

		PV
Accounts receivable	20.0%	593.3
	22.0%	589.2
	24.0%	585.2
	26.0%	581.1
	28.0%	577.0
	30.0%	573.0

In the table of parameters, we assumed that the accounts receivable, as a percentage of the annual revenues, is 20%. However, it could turn out that the accounts receivable is a different percentage. Thus, if the accounts receivable is 30% rather than 20%, then the PV of the net cash flow would be Iraqi Dinars 573 rather than Iraqi Dinars. 593.3.

Impact of changes in the expected inflation rate on the PV of the net cash flow

Table 7 shows the sensitivity analysis of the expected inflation rate on the PV of the net cash flow.

Table 7: Sensitivity analysis of the expected inflation rate on the PV of the net cash flow

		PV
Expected inflation rate	3.0%	595.0
	4.0%	594.1
	5.0%	593.3
	6.0%	592.5
	7.0%	591.7
	8.0%	590.9

Changes in the expected inflation rate have only small impacts on the PV of the net cash flow. For example, if the expected inflation rate is 8% rather than 5%, then the PV would be Iraqi Dinars 590.9 rather than Iraqi Dinars. 593.3.

Two-way table

In addition to the one-way tables, we can also construct two way tables. We illustrate with one example, where we show the impact of changes in the quantity of output and the initial price in year 0 on the PV of the net cash flow.

Table 8: Sensitivity analysis of the quantity of output and the initial price in year 0 on the PV of the net cash flow

	PV		Initial	output	price		
	593.30	16.0	17.0	18.0	19.0	20.0	21.0
	10.0	474.6	504.3	534.0	563.6	593.3	623.0
Quantity of output	11.0	522.1	554.7	587.4	620.0	652.6	685.3
	12.0	569.6	605.2	640.8	676.4	712.0	747.6
	13.0	617.0	655.6	694.2	732.7	771.3	809.9
	14.0	664.5	706.0	747.6	789.1	830.6	872.2
	15.0	712.0	756.5	801.0	845.5	890.0	934.5

Table 8 shows the relationship between the quantity of output and the initial output price on the PV of the net cash flow. The entries in the matrix in Table 8 show the PV of the net cash flow for different combinations of values for the quantity of output and the initial output price. For example, if the quantity of output is 12 units and the initial output price is Iraqi Dinars 18, then the PV of the net cash flow is Iraqi Dinars 640.8.

How do we interpret the rows and columns in Table 8? A row in Table 8 shows the relationship between the initial output price in year 0 and the PV of the net cash flow, for a given value of the quantity of output; and a column in Table 8 shows the relationship between the quantity of output and the PV of the net cash flow, for a given initial output price in year 0.

Importance of the key variables

Based on the results of the sensitivity analysis with all of the key parameters, we can identify and rank the set of key variables that will have the most impact on the NPV of the project. The relative importance of a variable depends on how much the NPV of the project changes due to a unit change in the key variable. Alternatively, we can calculate the percentage change in the NPV of the project due to a one percentage change in the value of the key variable. In addition, the selection of the important key variables will also depend on the experience, knowledge and judgment of the analyst, based on analysis from other comparable projects.

Sensitivity is a powerful tool for gaining insight into the impacts of key variables on the desired outcomes of a project. However, as we discuss below, there are several shortcomings with the sensitivity analysis.

The first shortcoming relates to the number of variables that sensitivity analysis can handle. With a one-way sensitivity analysis, we examine the impact of a single variable on the NPV of the project, holding constant the values of all the other key variables. With a two-way table, we can analyze the impact of two variables on the NPV of the project, holding constant the values of all the other key variables. For more than two variables, sensitivity analysis becomes cumbersome to conduct, and difficult to visualize and interpret. In any project, more than two variables will be changing simultaneously, and as part of the risk analysis, we must be able to analyze the impact of simultaneous changes in several variables on the NPV of a project.

The second shortcoming of sensitivity analysis concerns correlations that may exist among the variables. In sensitivity analysis, we assume that the different variables are independent and we are unable to model the important correlations that may exist among the key variables. For example, there may be a negative relationship between the price of the output and the quantity of the output. With an increase in the price, the quantity demanded may decrease. In sensitivity analysis, we cannot model this negative correlation between the price and quantity demanded.

The third shortcoming of sensitivity analysis is the absence of probability distributions for the key variables. In the sensitivity analysis, we did not specify the likelihood of the values that we used in the ranges for the various key variables. This deficiency could be solved by assigning discrete probabilities to the values that we use in the one-way and two-way tables. For example, for each of the four variables in the numerical example, we

could assign discrete probabilities distributions for the range of values. However, with multiple variables, it would be quite tedious to implement, and furthermore, the interpretation of the results would also be problematic.

As we shall see below, the use of Monte Carlo Simulation (MCS) is the natural way to overcome the shortcomings of the sensitivity analysis. Before discussing MCS, we briefly discuss an intermediate method, which is scenario analysis.

Scenario analysis

Scenario analysis is a partial remedy for the shortcomings of sensitivity analysis. Based on the set of key variables that have been identified through the sensitivity analysis, we describe three scenarios: best case (or optimistic case), expected case, and worst case (pessimistic case). Each scenario is based on a combination of possible values from the set of key variables. The analyst is not restricted to three scenarios, and could specify five or more scenarios. How many variables should we use in the specification of the scenarios? Four or five variables should be sufficient for practical purposes. With more variables, the construction and interpretation of the scenarios will be difficult.

How do we use the results of the scenario analysis? Under two extreme cases, we may decide as follows. If the NPV of the project is negative in the best case scenario, then it is reasonable to reject the project. Alternatively, if the NPV of the project is positive in the worst case scenario, then we should accept the project. In practice, the results may not be so clear cut.

Scenario analysis also suffers from the other shortcomings that we had identified previously in sensitivity analysis. We are unable to assess the likelihood of the different scenarios because the scenario analysis does not specify the probabilities for the values of the different variables that form the basis for the scenarios. Furthermore, we cannot specify the correlations that may exist among the variables.

Monte Carlo Simulation

Of the three methods mentioned above, Monte Carlo Simulation (MCS) is the most complicated method for risk analysis. MCS is a natural extension of sensitivity analysis and overcomes the two major shortcomings of sensitivity analysis. As a result, it also increases the level of complexity in the analysis. However, with the development of easy-to-use software, it is relatively simple to conduct sophisticated Monte Carlo Simulations for project appraisal.

With MCS, we can specify probability distributions for the key risk variables, specify correlations that exist among the risk variables, and can model a reasonably large number of variables in a sensible manner. By specifying the probability distributions for the variables, we obtain the probability distributions for any desired outcomes, such as the NPV of the project from different points of view.

In conducting a MCS, we undertake the following steps.

1. Mathematical model: project appraisal spreadsheet,
2. Identify variables that are sensitive and uncertain,
3. Define uncertainty
   a. Specify probability distributions

4. Identify and define correlated variables
a. Positive or negative correlation
b. Strength of correlation
5. Run the simulation model
6. Analysis of results
a. Summary statistics
b. Probability distributions of desired outcomes

Next we briefly comment on each of the steps for the MCS. In the first step we construct the mathematical model for the project appraisal. As mentioned earlier, we have to ensure that the desired outcomes, such as the NPV of the project from different points of view, are properly linked via formulas to all of the previous tables and to the key variables in the table of parameters. Without such proper linkages, we will not be able to conduct sensitivity analysis and the MCS.

In the second step, we conduct sensitivity analysis with one-way and two-way tables to identify the key risk variables. From a practical point of view, six to eight risk variables would be a reasonable number. If the project is particularly complex, then a larger number of risk variables may be justified. However, a complicated analysis with a lot of risk variables may not necessarily lead to greater insight about the risk of the project.

In the third step, we specify the probability distributions for the risk variables. Commonly used distributions are: the uniform, triangular and normal. If there is historical information or data on the risk variables, then we can use the historical information to guide us in the specification of the probability distributions. If there is no historical data, then we may have to rely on the opinions of experts or practitioners who may have good judgment on the likely range for the future movement of the values of the risk variables. Also, we may look for secondary data from the published literature and data for variables from other comparable and similar projects.

In the fourth step, we specify the direction (positive or negative) and strength of the correlations that may exist among the risk variables.

In the fifth step, we run the simulation model, and obtain the simulation results. The simulation results consist of summary statistics and probability distributions for all the variables and outcomes.

Interpretation of the simulation results

The most useful graphs are the cumulative probability distribution graphs for the NPV from different points of view. From the cumulative probability graph, the decision maker can easily determine the probability that the NPV of the project is positive.

For more details on the probability and statistical concepts that are relevant for risk analysis, please see the section on the foundations of risk analysis.

Chapter VIII: Risk Management

CHAPTER VIII: RISK MANAGEMENT

Next, we discuss risk management. In risk management, we examine different ways to structure the internal and external relationships in a project. We can use contracts and other arrangements to improve the incentives that the different stakeholders face.

Before discussing risk management, we briefly describe the sources of risk in a project.

Sources of risk in a project

What are the sources of risk in a project? The risks that affect a project can be external (or exogenous) or internal (endogenous). First, we consider different types of external risks: market risk for the product, financial and foreign exchange risk, government policy, natural resources and natural disasters. Second, we consider internal risks, such as relationships between prices and quantities, real options in project design, incentive relationships and endogenous behavioral relationships.

Market risk for the product

One of the main risks is the demand for the output of the project. A good marketing analysis can provide an assessment of the market risk for the product. In addition to the demand for the project, there is also the risk in the output price, and in the prices and quantities of the inputs and raw materials.

Foreign exchange risk

If there are cash flow items that are in foreign currencies, such as imported inputs or revenues from exports, then fluctuations in the foreign exchange rate will be a risk factor for the project.

Government policy and politics

Changes in government policy, such as tax policy, licensing and regulations, can affect financial and economic viability of the project.

Natural resources

In natural resource projects, the quantity of ore in the ground may be a risk factor.

Natural disasters

Natural disasters may be a risk for some projects. It is difficult to plan for the impact of natural disasters.

Internal risks to the project

In addition to the external risks that we have discussed, there are internal risks to the project.

Risk of the equity holder

Now we examine who bears the risk in a project. We write the expression for the return to equity as follows.

$$\text{Return to equity} = e \times E = p \times Q - m \times M - w \times L - d \times K - i \times D \quad (1)$$

Where

e is the return to equity, E is the equity investment,

p is the price, Q is the quantity,

m is the unit price of materials,

M is the units of materials,

w is the unit wage rate,

L is the units of labor,

d is the depreciation (as a percentage of the investment),

K is the investment,

i is the interest rate,

D is the value of debt, and

T is the taxes.

The return to equity equals the revenues less the costs, which consists of the input costs, labor costs, depreciation, interest payments and taxes.

We can rewrite equation 1 to obtain the expression for the net value added.

Net Value Added = $e \times E + i \times D + T + w \times L$
$= p \times Q - m \times M - d \times K$ (2)

The Left Hand Side (LHS) of equation 2 is the Net Value Added, which consists of the payments to the various stakeholders in the project, namely the equity holder, the debt holder, the government and the workers. The Right Hand Side (RHS) of equation 2 consists of the purchasers of the outputs and the suppliers of the inputs. Since the risk of the receipts to the stakeholders depends on the risks faced by the buyers and suppliers, the equity holders may wish to share the risk with them.

How are the costs of risks reduced? Some risks can be virtually eliminated by spreading the burden across many persons. Other risks cannot be spread; it can only be shifted or reallocated.

Different players in the market place have different preferences, willingness and capacity to bear risk. The cost of risk is lower for those with greater capacity and willingness to bear risk, and thus there are gains to be obtained from trading in the tradeoffs between risk and risk-return.

Debt financing and debt service capacity ratios

Typically, projects are financed with debt and equity. A viable project must generate sufficient cash flows to repay the principal and interest on a loan, and provide a positive equity return to the equity holder. The debt holder has the first claim on the cash flow, and the equity holder is the residual claimant. For example, if the cash flow is just sufficient to pay the debt holder, then the equity holder may receive nothing. Since the risk of the cash flow to the equity holder is higher than the risk of the cash flow to the debt holder, the required equity return is higher than the cost of debt charged by the debt holder.

The debt can be made more secure with guarantees, collaterals and specified returns. Equity holders have the incentive to increase low-cost debt financing to increase the returns to

The debt holder would like to ensure that the debt is repaid with a reasonable likelihood. The Debt Service Capacity Ratio (DSCR) is a common criterion for evaluating the financial viability of a project from the perspective of the debt holder. The DSCR tells the financier (or banker) whether there is enough cash from the project over the long run to justify bridge financing when some years have inadequate cash flows to service the debt.

Annual Debt Service Capacity Ratio (ADSCR)

The Annual Debt Service Capacity Ratio (ADSCR) is the ratio of the annual free cash flow to the annual debt repayment.

Debt Service Capacity Ratio (DSCR)

The Debt Service Capacity Ratio (DSCR) is the ratio of the present value of the free cash flow, discounted at the loan interest rate, to the present value of the loan repayment, discounted at the loan interest rate, from the current period till the end period of the loan repayment,

Numerical example

Consider a project that requires Iraqi Dinars 2 million for investment. The proposed loan is for Iraqi Dinars 1 million and the remaining Iraqi Dinars 1 million is financed with equity contribution. The required rate of return for equity is 20%; the cost of the loan is 15%, and the loan is repayable in 5 equal installments.

Table 1: Annual Debt Service Capacity Ratio (ADSCR)

Year	0	1	2	3	4	5	6	7	8	9	10
Net cash flow ('000)	-2,000	320	320	360	440	380	100	200	480	540	640
Debt repayment ('000)		298.3	298.3	298.3	298.3	298.3					
ADSCR		1.073	1.073	1.207	1.475	1.274					

Using the PMT function in EXCEL, we calculate that the annual equal payment for the loan is Iraqi Dinars. 298.3 thousand. Next, we calculate the ADSCR, which is simply the ratio of the annual net cash flow to the debt repayment. Since the loan payment is constant, the value of the ADSCR depends on the value of the annual cash flow, and it is highest in year 4, when the cash flow is Iraqi Dinars 440 thousand. This project is not attractive to the financiers because the ADSCRs are low. It means that the net cash flow may not be enough to meet the debt service obligation and to obtain the required rate of return on equity.

How can we improve the annual debt service capacity ratios? There are three possibilities:

1. Decrease the interest rate on the loan
2. Decrease the amount of borrowing and
3. Increase the duration of the loan repayment

Decreasing the interest rate on the loan

One way to improve the ADSCR is to lower the interest rate on the loan. Suppose the interest rate is 1% rather than 15%. Then as shown below, the ADSCR is much higher.

Table 2: Annual Debt Service Capacity Ratio (ADSCR) with lower interest rate

Year	0	1	2	3	4	5	6	7	8	9	10
Net cash flow ('000)	-2,000	320	320	360	440	380	100	200	480	540	640
Debt repayment ('000)		206.0	206.0	206.0	206.0	206.0					
ADSCR		1.553	1.553	1.747	2.136	1.844					

With a lower interest rate, the ADSCR looks much better but it may not be possible to obtain a lower interest rate, except through guarantees or subsidies, such as IDA financing.

Decrease the amount of borrowing

Another way to improve the ADSCR is to lower the amount of loan. Suppose the amount of the loan is lowered from Iraqi Dinars 1 million to Iraqi Dinars 600,000 at 15%. The new ADSCR is shown in the table below. Since the proportion of borrowing in the total investment decreases, the amount of the annual repayment of the loan also becomes smaller. Hence the ability to service the debt becomes more certain.

Table 3: Annual Debt Service Capacity Ratio (ADSCR) with lower amount of loan

Year	0	1	2	3	4	5	6	7	8	9	10
Net cash flow ('000)	-2,000	320	320	360	440	380	100	200	480	540	640
Debt repayment ('000)		179.0	179.0	179.0	179.0	179.0					
ADSCR		1.788	1.788	2.011	2.458	2.123					

Again, we see that the ADSCR has improved.

Increase the duration of the loan repayment

A third way to improve the ADSCR is to increase the duration of the loan repayment from five years to ten years. Increasing the duration of the debt repayment improves the ADSCR because the same amount of loan is repaid over more years. However, the lower ADSCRs in years 6 and 7 due to the low cash flow in those years mean that the project is unable to meet the loan obligations in those years.

Table 4: Annual Debt Service Capacity Ratio (ADSCR) with longer duration for loan repayment

Year	0	1	2	3	4	5	6	7	8	9	10
Net cash flow ('000)	-2,000	320	320	360	440	380	100	200	480	540	640
Debt repayment ('000)		199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3
ADSCR		1.606	1.606	1.807	2.208	1.907	0.502	1.004	2.409	2.710	3.212

The project may face difficulties if the net cash flows are insufficient to serve the debt in some years. Would it be viable to obtain bridge-financing to meet the existing debt payments in some years?

To find out if the bridge financing is worth undertaking, we need to look at the cash flows and debt repayments over the remaining period of the loan.

Bridge financing

The DSCR is the appropriate criterion for determining the viability of bridge financing. Although the annual debt service capacity ratios in years 6 and 7 are very low, the ability of the project to generate cash in subsequent years should be enough to obtain the bridge-financing for the two critical years.

Table 5: Debt Service Capacity Ratio (DSCR) to determine viability of bridge financing

Year	0	1	2	3	4	5	6	7	8	9	10
PV of NCF @ 15.0 %	1,784	1,732	1,672	1,563	1,357	1,181	1,258	1,247	953	557	
PV of CFD @ 15.0 %	1,000	951	894	829	754	668	569	455	324	173	
DSCR		1.784	1.822	1.870	1.885	1.800	1.768	2.211	2.740	2.944	3.212

Risk spreading and pooling

The most fundamental mechanism for reducing (or even eliminating risk) is risk spreading or pooling. As long as the variation in a particular return is unsystematic or unrelated to the other returns, then the variation can be reduced in line with the number of people sharing the return. By spreading the risk across a pool of persons (each owning a small share of the risk), the variability can be reduced to zero if the pool is large enough.

To understand the idea of risk spreading, we discuss some basic variance relationships.
Let X and Y be two random variables, and let a and b be constants.

Var(X) is the variance of X, Var(Y) is the variance of Y and Cov(X,Y) is the covariance of X and Y.

It is easy to show that the following variance relationships hold.

$$Var(aX) = a^2 \times Var(X) = a^2 \times (\sigma_X)^2 \quad (1)$$

$$Var(aX + bY) = a^2 \times Var(X) + b^2 \times Var(Y) + 2ab \times Cov(X,Y)$$

$$= a^2 \times (\sigma_X)^2 + b^2 \times (\sigma_Y)^2 + 2ab \times Cov(X,Y) \quad (2)$$

The first relationship states that the variance of constant times a random variable X equals the square of the constant times the variance of X. The second relationship applies to the sum of two random variables. Note the presence of the third term, which includes the covariance between X and Y.

If X and Y are independent random variables, then it means that they are unrelated and the covariance between them is zero. In this special case, we can simplify equation 2 as follows.

$$Var(aX + bY) = a^2 \times Var(X) + b^2 \times Var(Y)$$

$$= a^2 \times (\sigma_X)^2 + b^2 \times (\sigma_Y)^2 \quad (3)$$

Now let R be the return on a new investment project and let Var(R) be the variance of R. Suppose there are N investors and the investment project is equally divided among the N investors. Then the variance for an individual investor is just one nth of the variance of R.

$$\text{Variance for individual investor} = Var(R/N) \quad (4.1)$$

The total variance for all of the investors is as follows.

$$\text{Total variance for all investors} = N \times Var(R/N) \quad (4.2)$$

We can rewrite equation 4.1 as follows.

$$\text{Total variance for all investors} = N \times Var(R/N) = N \times (1/N^2) \times Var(R) = Var(R)/N \quad (4.3)$$

Thus, we see that if the investment project is shared or owned by N investors, then the total variance for all the investors equals the variance of the project divided by N. As N gets large, the total variance tends towards zero. However, the expected total return remains the same.

Equation 6 is the basis for risk spreading or pooling. The total variance of the unsystematic risk declines towards zero as the risk is spread among many investors.

Thus investors can spread (or pool) risks of investments across many different investments to reduce the unsystematic risk that is inherent in each investment.

We illustrate these ideas with a simple numerical example. Assume there are 100 companies in the oil exploration business. The probability of finding oil is 50%.

Table 1: Statistics for oil exploration for a single company

Outcomes	Probability	Profit (Rs. million)	Rate of return (R)
a. Find oil	0.50	1.40	140%
b. Do not find oil	0.50	-1.0	-100%

If a company finds oil, the profit is Iraqi Dinars. 1.40 million and the rate of return is 140%. On the other hand, if the company does not find oil, then the profit is –Iraqi Dinars. 1.0 million and the rate of return is -100%.

The expected return E(R) is 20% and the standard deviation is 120%

Expected return = E(R) = 50%×140% + 50%×-100% = **20.0%** (5.1)

$Var(R) = (1.4 - 0.20)^2 \times 0.50 + (-1.0 - 0.20)^2 \times 0.50 =$ **1.440** (5.2)

$Std(R) = \sqrt{((1.4 - 0.20)^2 \times 0.50 + (-1.0 - 0.20)^2 \times 0.50)} =$ **1.200** (5.3)

If a single investor puts all her money in the shares of one company, then the risk would be very high. Alternatively, the single investor could construct a portfolio that consists of one hundredth of the shares in each of the 100 companies. The return and risk of this portfolio would be as follows.

$E(R) = 20\%$ (6.1)

$Var(R) = (\sigma_R)^2 = 1.44/100 = 0.0144$ (6.2)

$Std(R) = \sigma_R = 0.12$ or 12% (6.3)

With the portfolio, the expected return for the investor remains the same as before, however the standard deviation has been reduced from 120% to 12%.

If 100 investors were to buy one hundredth of the equity in the oil exploration project, then the expected return and risk would be the same as that for the portfolio.

Systematic risk

Next, we explore the notion of systematic risk and the relationship of the new project investment to the existing portfolio of investments. When a new investment is undertaken, we need to distinguish between the risk or variability in the return or NPV of the new project and the impact that the project has on the variability of the returns of the entire portfolio of investments of the investors in the project and the economy.

Systematic risk refers to the covariance (or correlation) between the returns on the new project and the returns on the existing portfolio of investments of private investors or all investments in the economy.

Investors demand a price or risk premium to bear risk or variability in return. To reduce the variability in returns of individual investors, it is common practice to spread the ownership among many owners. This reduces the variability in returns from the new project but necessarily in aggregate when the variability is viewed in conjunction with existing investments. It is possible to show these concepts with basic variance relationships.

Let ρ_{XY} be the correlation coefficient between X and Y. Then the relationship between the correlation coefficient and the covariance is as follows.

$$\rho_{XY} = Cov(X,Y)/(\sigma_X \times \sigma_Y) \quad (7.1)$$

Solving for the covariance, we obtain,

$$Cov(X,Y) = \rho_{XY} \times \sigma_X \times \sigma_Y \quad (7.2)$$

From above, we know that,

$$Var(aX + bY) = a^2 \times (\sigma_X)^2 + b^2 \times (\sigma_Y)^2 + 2ab \times Cov(X,Y) \quad (8.1)$$

Substituting equation 7.2 into equation 8, we obtain,

$$Var(aX + bY) = a^2 \times (\sigma_X)^2 + b^2 \times (\sigma_Y)^2 + 2ab \times \rho_{XY} \times \sigma_X \times \sigma_Y \quad (8.2)$$

Regression analysis

From the standard OLS (Ordinary Least Squares) regression analysis, we obtain the following results. Assume that there is a linear relationship between Y and X, where ε is a random variable with a normal distribution and zero mean.

$$Y = \alpha + \beta \times X + \varepsilon \quad (9)$$

The intercept is α and the slope coefficient is β. We can show that the slope coefficient equals the ratio of the covariance of X and Y, and the variance of X.

$$\beta = Cov(X,Y)/Var(X) \quad (10)$$

Substituting the expression for the covariance, we obtain the following equation for the slope coefficient.

$$\beta = Cov(X,Y)/Var(X) = \rho_{XY} \times (\sigma_X) \times (\sigma_Y)/(\sigma_X)^2 = \rho_{XY} \times (\sigma_Y/\sigma_X) \quad (11)$$

Incremental systematic portfolio risk

To assess the impact on the risk of an investor, it is necessary to check how the new investment co-varies with the existing portfolio and estimate the incremental impact on the portfolio risk of the investor. Let R be the return on the new investment project and P is the return on the existing portfolio. Then,

$$\text{Var}(R + P) = (\sigma_R)^2 + (\sigma_P)^2 + 2\rho_{RP}\times\sigma_R\times\sigma_P \quad (12.1)$$

Substituting the expression for the slope coefficient, we obtain,

$$\text{Var}(R + P) = (\sigma_R)^2 + (\sigma_P)^2 + 2\beta\times(\sigma_P)^2 \quad (12.2)$$

The variance of the new project $(\sigma_R)^2$, is the variance resulting in the diversifiable risk that can be reduced through risk pooling or spreading. The covariance term gives the incremental non-diversifiable or systematic risk for the portfolio of the investor. The systematic risk is a real unavoidable cost to investors. The systematic risk is not reduced if the government rather than the private sector undertakes the project.

Mechanisms for reducing the costs of risk

There are four main mechanisms for reducing the costs of risk. First, we can use the capital, financial and futures markets. Second, we can use contracts to reallocate or share the cost of risk reduction. Third, there are real options. And fourth, we can use project finance.

Capital, financial and futures markets

Typically, investments are financed with a combination of debt and equity. The financing for a project can be raised in the financial markets. The financial structure, that is, the mix of debt and equity, results in different payoff structures for the debt and equity holders.

Contracting

To reduce the costs of risk, we can use contracts to reallocate or share risks. Contracts can change the internal relationships to deal with exogenous market variability, such as foreign exchange risk. For example, contracts may use product price formulas.

We can also use contracts to limit exogenous market variability in prices and quantities of raw materials.

Contracts are also relevant for changing the internal relationships and thus change the endogenous incentives. Examples include profit sharing, stock options and other flexible wage agreements. In addition, there can be profit participation by the construction contractor and operator.

Real options

With real options, we can design flexibility into the project. The real options allow us to respond to changes in information or market conditions. There is a cost to the added flexibility and thus we have to compare the benefits of the flexibility with the cost of increasing the flexibility in the project.

Project finance

Project finance consists of complex contractual arrangements to deal with risk in large investments. In non-recourse project finance, the stakeholders in the project only have claims to the cash flow that is generated by the project. Thus, it is important to structure the contracts in such a

way that all the claimants to the cash flow satisfy their required rates of return.

Capital Asset Pricing Model (CAPM)

If investors can establish well-diversified portfolios and have a risk-free investment available (such as a government bond), then they can invest in a mix of the risk-free investment and their investment portfolio.

If individual investors have no special information, the portfolio of the individual investor should be similar to the market portfolio. Hence, investors can choose an investment mix of the risk-free and market portfolio which plots out the "market line" running from the risk-free return through the market return at the market standard deviation. Therefore no investment should pay a return that falls below this line given the variability in its return.

Let r_m be the return on the market portfolio and r_f be the risk-free rate. The market pays a risk premium of $(r_m - r_f)$, which is the difference between the return on the market and the risk-free rate. The risk premium paid on any particular investment should be proportional to its contribution to the market portfolio risk premium. This relationship to the market portfolio of the returns on any investment (r_j) is measured by its "beta" (β_j). Hence the CAPM is expressed as:

$$r_j - r_f = \beta_j \times (r_m - r_f) \qquad (1)$$

Or the return on any investment should be the risk-free return plus its "beta" times the market risk premium. The beta β_j for any investment "j" can be found by regressing the returns for that type of investment on the market return. In the extreme case, the risk-free investment has a beta of zero, and as expected, the return on the investment equals the risk-free rate. On the other hand, if the investment has a beta of one, then the risk of the investment equals the risk of the market portfolio.

Another perspective can be gained from the following expression.

$$\beta_j = \rho_{j,market} \times (\sigma_j / \sigma_{market}) \qquad (2)$$

We can express the beta in terms of the correlation between the investment and the market portfolio $\rho_{j,market}$, the standard deviation of the investment σ_j and the standard deviation of the market σ_j. The beta rises with the degree of correlation of the return on investment "j" with the market and the variance in the return on the investment itself.

Risk allocation: sources of contracting risks

In developing countries, well-developed capital, financial and futures markets are not always available. Investors can use contracts to shift and share risks. Special contractual arrangements are often required to mitigate risks and make projects viable. We can view contracts from either the cost perspective or the efficiency perspective. The cost perspective is implicitly a zero-sum perspective. What one party gains, the other party loses. An efficiency perspective is explicitly a positive sum perspective. With the right contract, one party may be able to gain substantially without a corresponding cost to the other party.

Risk shifting of exogenously generated risks

First, investors have different risk preferences. And a less risk-averse investor may be willing to accept a lower return on a risky asset. Second, different stakeholders have different capacities to diversify. For

example, foreign investors may have more opportunities to diversify their investments in efficient capital markets. Third, there are differences in the outlooks, predictions and information about the future. Some investors may be more optimistic than others.

Contracts that restructure intra-project correlations

Risk sharing can change the endogenous incentives because different stakeholders have differing ability to influence project outcomes. We can use contracts to reduce the risk profile of the project cash flow. There are two possibilities. First, we can structure risk-sharing contracts that reduce the investors' risk by increasing the correlation between sales revenues and some cost items. Examples include:

- Profit sharing contracts with labor
- Bonds with interest rates indexed to producer sales price
- Debt financing in the same currency as the product sales
- Product price indexed to major raw materials price

Second, we can use contracts that decrease the correlation between benefit items or alternatively between cost items.

The formal demonstration of these ideas is as follows. Earlier, we had presented the following equation for the variance of two random variables.

$$\text{Var}(aX + bY) = a^2 \times \text{Var}(X) + b^2 \times \text{Var}(Y) + 2ab \times \text{Cov}(X,Y)$$
$$= a^2 \times (\sigma_X)^2 + b^2 \times (\sigma_Y)^2 + 2ab \times \text{Cov}(X,Y) \quad (3)$$

For our purposes, let X be the revenues R, let Y be the costs C, let a equal 1, and let b equal -1. Then we can rewrite equation 1 as follows.

$$\text{Var(Net profits)} = \text{Var}(Y - C) = \text{Var}(R) + \text{Var}(C) - 2 \times \text{Cov}(R,C) \quad (4)$$

Any measure that increases the positive correlation between revenues and costs will increase the Cov(R, C), and in turn this reduces the variance of the net profit (provided of course that the measure does not increase the variance of a cost item by more than twice the change in the covariance.)

Profit-sharing agreement with labor

Assume that wages are the only cost. Without the agreement, the labor cost is C. Next we examine the labor cost with agreement. Let g be the proportion of the costs that is still paid to workers as a fixed part of the wage, and let h be the labor's share of profit after wages have been paid.

$$\text{Thus total cost} = g \times C + h \times (R - g \times C) \quad (5)$$

Where the first term is the fixed wage and the second term is the flexible wage.

$$\text{Net profit} = R - g \times C - h \times (R - g \times C)$$
$$= (1 - h) \times R - g \times (1 - h) \times C \quad (6)$$

The expression for the variance of the net profit is as follows,

$$\text{Var(Net profit)} = (1 - h)^2 \times \text{Var}(R) + g^2 \times (1 - h)^2 \times \text{Var}(C) + \text{Var}(R) + 2 \times g \times (1 - h) \times \text{Cov}(R,C) \quad (7)$$

And if $0 < g < 1$ and $0 < h < 1$, then the variance of net profit is lower than it is without the wage agreement.

Real options

Project design decisions that we make today affect the flexibility in responding to uncertain opportunities or constraints in the future. We discuss several examples. First, we could buy a larger land area than currently needed. This would give us the opportunity (or "real option" as compared to a financial option) to expand the future production of output in the event that demand is stronger than expected. Second, we could buy a more expensive machinery; however, the higher cost of the equipment is offset by the greater benefits that we obtain from the flexibility in changing product lines or using different types of materials. Thirdly, we may forego the tax incentives to enter an export processing zone because the location in the export processing zone does not allow us to sell in the domestic market when there is a downturn in the export market. Fourthly, we may prefer to have a lower target debt-equity ratio to avoid debt restructuring costs if there are declines in the future cash flows.

Summary of Project Appraisal Results

SUMMARY OF PROJECT APPRAISAL RESULTS AND RECOMMENDTION FOR ACTION

The following Table X.1 provides a summary of the basic results expected from the appraisal of an investment project using the financial, economic, stakeholder and risk analysis techniques discussed in the previous sections.

Table X.1 Summary of project appraisal results

Criterion or Result	Primary or Basic		Secondary
	Self-financing project	**Non-self-financing project**	
Economically attractive? NPV for economy	$NPV_{econ} > 0$. Also, $IRR_{economic}$ > economic discount rate	$NPV_{econ} > 0$ Also, IRR economic > economic discount rate	Probability of $NPV_{econ} < 0$, Standard deviation, maximum and minimum values or confidence intervals. Sources of risk.
Financially attractive to equity holders or sponsors? NPV for equity holders or sponsors	$NPV_{equity} > 0$. Also, IRR equity > minimum required ROE (return on equity)	$NPV_{sponsor}$ such that injections of funds are available in both investment and operating periods to cover any negative cash flows	Probability of $NPV_{equity} < 0$, Standard deviation, maximum and minimum values or confidence intervals. Sources of risk, Impacts of risk sharing contracts, sales or purchase agreements.
Financially attractive to combined financiers? NPV to total investment	$NPV_{total\ investment} > 0$. $NPV_{total\ investment} = NPV_{equity}$. Also, IRR total investment > minimum required return on investment ROI (WACC)		Adequate debt coverage ratios or sufficiently low probability of default relative to default premium charged
NPV to stakeholders consistent with NPV for economy	NPV_{econ} = sum of NPV to stakeholders	NPV_{econ} = sum of NPV to stakeholders	
NPV to key stakeholders	NPV to equity holders, NPV to adversely affected groups through environmental impacts, labor adjustment or social dislocation	NPV to target beneficiary group, particularly for social program delivering basic needs	Standard deviation, maximum and minimum values or confidence intervals. NPV of target group relative to NPV economy: win-win or target groups wins at expense of economy?

Based on the set of results derived from a comprehensive analysis of an investment project the following is the typical range of recommendations:

1. For a self-financing project, where it is:

   1.1 both financially and economically attractive with manageable risks and no key stakeholder group expected to experience major unintended gains or losses, the project should proceed as designed.

   1.2 subject to government regulation or participation agreements and is economically attractive and excessively attractive to the private investors, the project should proceed but with reduced gains to the private investors through adjusting contract prices or otherwise renegotiating the agreements.

   1.3 economically attractive, but financially unattractive to the stakeholders, the regulated prices or contract agreement should be adjusted to make the contract sufficiently attractive to the private investors by adjusting prices and/or introducing risk sharing arrangements to reallocate risks and/or improve performance incentives.

   1.4 financially attractive, but economically unattractive (as may occur in a protected or subsidized sector), the degree of protection or subsidy should be reduced such that the investment becomes economically attractive, if feasible.

   1.5 both financially and economically unattractive, it should be reconsidered for project redesign – changed scale, timing, technology, real options, and/or financial and contractual arrangements – to assess whether the project can be made attractive under new design parameters or agreements.

2. For a non-self-financing project, where it is

   2.1 economically attractive, has secure operational finances and the target beneficiary group experiences intended gains (typically from added supply of a basic need), and no key stakeholder group expected to experience major losses, the project should proceed as designed.

   2.2 economically attractive, but has insecure operational finances, it should be reassessed based on reduced production of services and beneficiary gains to assess whether it remains economically attractive under realistic financing levels for its operations; otherwise it should be deferred until financing of its operations can be assured.

   2.3 economically unattractive, has secure operational finances and the target beneficiary group experiences intended gains (typically from added supply of

a basic need), the project should be considered for redesign to determine whether at a different scale or with a different technology it can deliver adequate benefits to the target stakeholders, but with either positive economic gains or limiting the economic losses to a small share (say below 20%) of the gains of the target group; otherwise reject the project[18].

[18] The beneficiary group could be assisted with a cash transfer equal to their expected gain less the economic cost of raising and administering the funds transferred (typically about 20% of the funds.)

Appendixes

Appendix 1: Economic Externalities

Introduction

In an economy where there are no taxes, subsidies, or market imperfections such as monopoly, external costs/benefits (pollution, congestion, common-property), at the margin there is no divergence between the value of a good or service as manifested by its demand price and the cost of production as represented by the supply price. In this kind of ideal world, the financial and economic prices of outputs and inputs are the same and there is no difference between the financial appraisal of an investment and its economic evaluation. These distortions and imperfections, however, exist in real markets and can be the source of external welfare effects that should be taken into account while estimating the economic impacts of production or use of a product by the project.

Economic externalities are said to exist when the economic value of a product is different from its financial price. For example, to the extent that the economic benefit (value) to the society of the incremental output of a project is greater than the financial price received by the project owners, a positive externality is created. When building up the economic benefits from the financial receipts, all externalities should be added to the financial receipts. Similarly, if the economic costs of the resources required by a project exceed their financial cost, a negative externality is created that should be added to the financial expenditures incurred by the project. Annex IV presents an example of the different types of externalities that one may usually come across while appraising a project and also demonstrates how they are accounted for in moving from the financial to the economic analysis.

In some circumstances externalities could also arise due to the impact of the project on other industries, particularly industries producing close complementary and substitute goods, or externality might exist in industries producing inputs to the intermediate goods used by the project. If industries producing complementary or substitute goods experience changes in demand or supply, which in turn lead to a price change or a change in government revenues, an externality is created. One should carefully analyze the situation to determine whether the impact on substitutes and complements is expected to be small and could be ignored for practical purposes, or is large and should be included in the analysis.[19] Similarly, if an externality exists in the market for one of the inputs of an intermediate good required by a project and it is sufficiently large, it would be necessary to include it in the analysis.

What is Economic Externality?

All the distortions and imperfections in the markets for both traded and non-traded goods or services may be included in the term "economic externality" defined in a broader sense. Economic externality arises because of a divergence between the marginal social value and the marginal

[19] For a detailed analysis of incorporating the impacts of a project on complementary and substitute markets, see Harberger, A. and Jenkins, GP., "Manual for Cost Benefit Analysis of Investment Decisions", Unpublished, Chapter 11, Section 3 (HIID, Harvard University 2005)

social cost of activities whose demand or supply is affected by a project. While physical or technological externalities refer to effects like noise, pollution or congestion, the term "economic externality" would cover all potential sources of external welfare effects that have been described above. With this connotation, "economic externality" may be defined as follows.

An externality or external economy (diseconomy) is an occurrence or incident that confers benefits (damages) on some persons who are not fully consenting parties in reaching the decision that gives rise to the event in question[20].

It may be noted that an economic externality arises when the persons affected were not fully consenting parties to the decision. For instance, in case of taxes and subsidies the affected individuals might have been a party to the process leading to the installation of the government (voting), but they are not a party to the institutional process through which these measures are approved. As a result, each time that a project causes a change in the level of a taxed activity that yields more or less tax revenues to the government, an externality arises.

There are several situations where an economic externality may arise. Some of the cases of externalities that are of relevance while appraising a project are described below.

Environmental Externalities

Environmental externality is generated when the external diseconomy arises as a result of the production process of a project. The different kinds of pollution created by industrial firms and infrastructure projects (power, transport) in the process of producing goods and services fall in this category. A lot of waste products or effluents are deposited in the atmosphere, waterways and the ground by some projects. This has a damaging effect on people and property that are not directly involved with the production or consumption of the output.

Accounting for Environmental Externalities in Project Appraisal

Whenever an investment has an adverse impact on the environment, there are two steps to incorporate this effect into project evaluation. First, the cost of measures necessary to reduce or eliminate the impact should be part of the project and the costs of those measures should be included both in the financial and economic analyses of the project. These measures may include alterations in the existing plant or adding some new equipment. If the impact on the environment cannot be totally eliminated, as would generally be the case, then the damage caused by the residual impact should be estimated and added as a cost in the economic analysis of the project. This evaluation of the residual impact on the environment and consequently on the people may not be always straightforward and may often require special evaluation techniques.

Monopoly Externalities

Sometimes there is only one producer of a good or service in the economy and he enjoys a monopoly in the market. The monopolist is in a position to set the price

[20] This definition is due to James E. Meade; "The Theory of Economic Externalities", Institut Universitaire de Hautes Etudes Internationales, Geneva (1973).

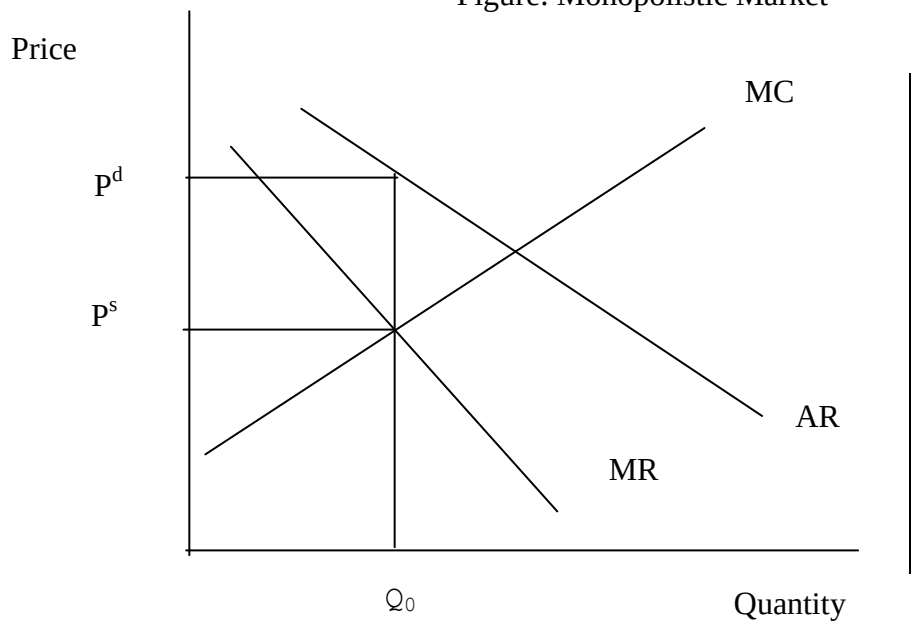
and then sell the output that is demanded by the consumers at that price. From an alternative perspective, the monopolist can restrict the output which will raise the price of the good/service in the market over and above its marginal cost of production[21]. Compared to the situation in a competitive market, the amount of the good/service transacted in the market is lower and the price is higher. As a result, consumers lose and the producer gains at the cost of consumers. The determination of price and quantity in a monopoly market is depicted in the figure below.

A monopoly may arise due to a variety of reasons. There may be a single owner of a resource that is crucial to the production process; there may be some legal or institutional barriers to the entry of other producers; or there may exist a natural monopoly arising from economies of large scale production that leaves no scope for more than one producer[22].

[21] This price difference is sometimes referred to as a monopoly tax. The consumers have to pay a higher price compared to the situation in a competitive market as if the monopolist is imposing a tax on them. As a consequence, the consumer surplus declines and the producer surplus is higher.

[22] The single ownership situation may arise in case of natural resources. The legal/institutional barriers often have their origin in some patent law. The natural monopoly occurs in case of large scale utilities such as railways and telecommunications.

Figure: Monopolistic Market



AR = Average Revenue
MR = Marginal Revenue
MC = Marginal Cost
P^d = Price Paid by Consumer
P^s = Marginal Cost of Production
P^d - P^s = Monopoly Tax

Whatever be the cause of the monopoly, the result of a monopolistic market is a divergence of selling price from the marginal cost. The way in which this leads to the rise of externalities may be seen from analyzing the situation in which the demand for the product of the monopolist increases over time. This may be due to a change in preference or simply an increase in population over time. The monopolist producer may react to this in one of the two ways: (a) producing and selling the same quantity of product as before but at a higher price; or (b) increasing the output and selling a larger quantity at the same price.

In the first scenario, there is a redistribution of income from the previous consumers to the producer. With respect to the product that the previous purchasers continue to purchase but at a higher price, a larger sum of money is paid for the same quantity. Thus the monopolist producer gains at the cost of the previous consumers. This happens due to an increase in demand of the product by other consumers, a decision in which neither the previous consumers nor the producer played any part and to which the previous consumers were not a consenting party. This is an external economy to the monopolist and an equal offsetting external diseconomy

to the previous consumers[23]. This transfer from the consumers to the producers is relevant for analyzing the distributional impact of the project.

In the second scenario, the monopolist producer sells more at the same price because of the new set of consumers. Thus the monopolist benefits without hurting any one else and because of the decision of the new buyers to which he was not a party[24]. For the sake of argument, if this producer is the only monopolist in the economy while there is perfect competition every where else including the labor market, there will be a divergence between social cost and social value in the monopolist's market but nowhere else. Any development that increases the sale of the monopolist's output will enhance his total real income without making any one else worse off.

Tax, Tariff, Subsidy Externalities

Taxes are imposed by the governments in order to raise revenues for the government and the public sector. The purpose of this revenue is to achieve some objective of public expenditure[25]. Taxes combined with subsidies may be viewed as instruments of redistribution of income in the society. Import duty and export taxes (subsidies) may serve the purpose of raising revenues and also for giving specific direction to the trade policy of the state. When a tax, a tariff or a subsidy is imposed on any good or service, there is a divergence between the marginal value and marginal cost of production.

Tax and Subsidy in the Market of Non-traded Goods

When a tax or tariff is imposed the value of the unit of the commodity to the consumer is given by the price of product inclusive of tax. The cost of production, on the other hand, is the price excluding the tax. A tax (t) or tariff will cause the marginal value to be higher than the marginal cost while a subsidy (k) will have an opposite impact.

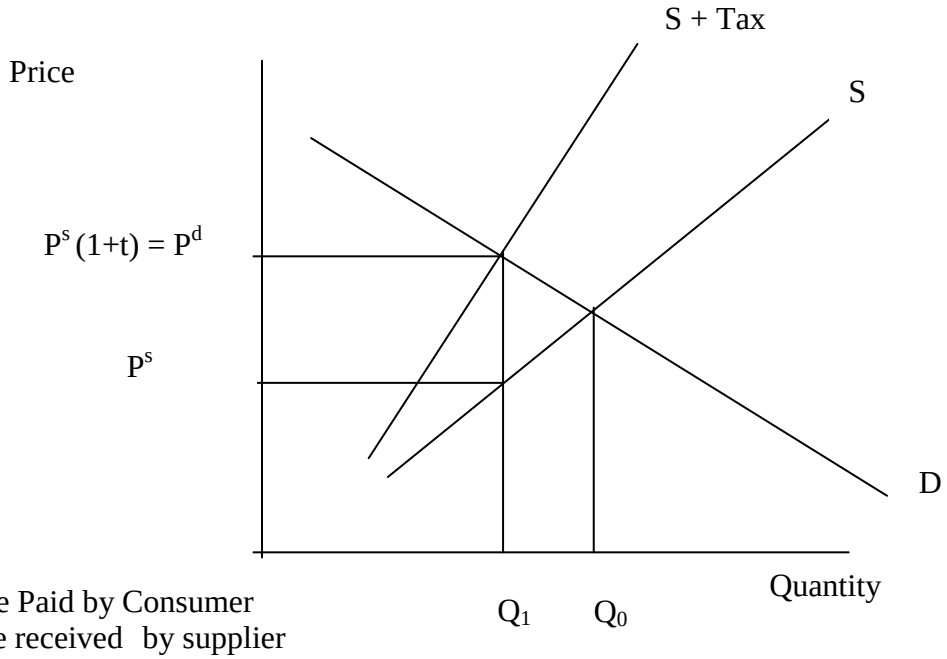
Thus the additional revenues to the government due to the purchase of that item represents the excess of benefit over cost. Also, the beneficiaries of the activities of the government that are financed by these tax revenues have a real income gain. By purchasing an additional unit of the taxed item, a consumer creates external economy that is to the benefit of some one else.

[23] In this case the external effect takes the form of redistribution of income due to an increase in price of the product and this is sometimes referred to as "distributional externality".

[24] This is the case of a "real income externality" in which the benefit to the producer is not due to transfer from some one else in the economy.

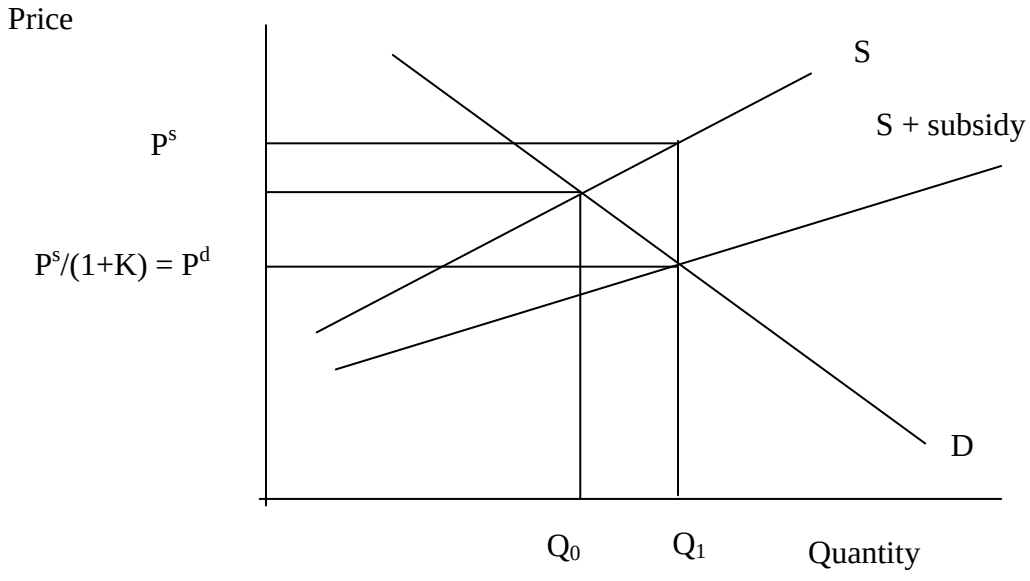
[25] The purpose of raising revenues is to enable the government to perform functions that cannot be undertaken by the private sector due to "market failures". The government is also required to adopt appropriate fiscal and monetary policies for the stabilization of the economy. Also, expenditures in social sectors (healthcare, education) are necessary for reducing income disparities and promoting equity.

Figure: Tax



P^d = Price Paid by Consumer
P^s = Price received by supplier

Figure : Subsidy



It may be pointed out that the decision maker in the case of imposing a tax or extending a subsidy is the government or the legislature. The people affected by this decision could be a party to electing the law-makers but they cannot be said to be a fully consenting party to the decision making process for imposing specific taxes and subsidies.

Import Duty and Export Tax in the Market of Traded Goods

When import duty is imposed on goods imported in the country, there is again a divergence between the marginal cost of the item and the marginal value to the consumers. The marginal cost to the economy is the international price P_w at which the item is imported while the marginal benefit is the tariff (t) inclusive price P_w (1+t) paid by the consumers. This is depicted in figure below. The additional revenue to the government represents the excess of benefit over cost.

When there are export taxes or export subsidies, a similar situation arises and there is a difference between the economic benefit and the economic cost of the exported item. The economic cost is P_w while the economic benefit is P_w (1-t). The case of export tax is shown figure below.

As a consequence of taxes, tariffs and subsidies economic externalities also arise in the markets of foreign exchange and labor. These two types of externalities are discussed in the following two sections.

Foreign Exchange Externality

The foreign exchange externality is meant to capture any indirect external welfare effects that result from a project's incremental use or production of foreign exchange. The source of this externality lies in the divergence that exists between the marginal value of a unit of foreign exchange and the marginal cost of earning that unit. This divergence is ultimately due to distortions in the markets underlying the demand and supply of foreign exchange.

Figure: Distortion due to an Import Duty

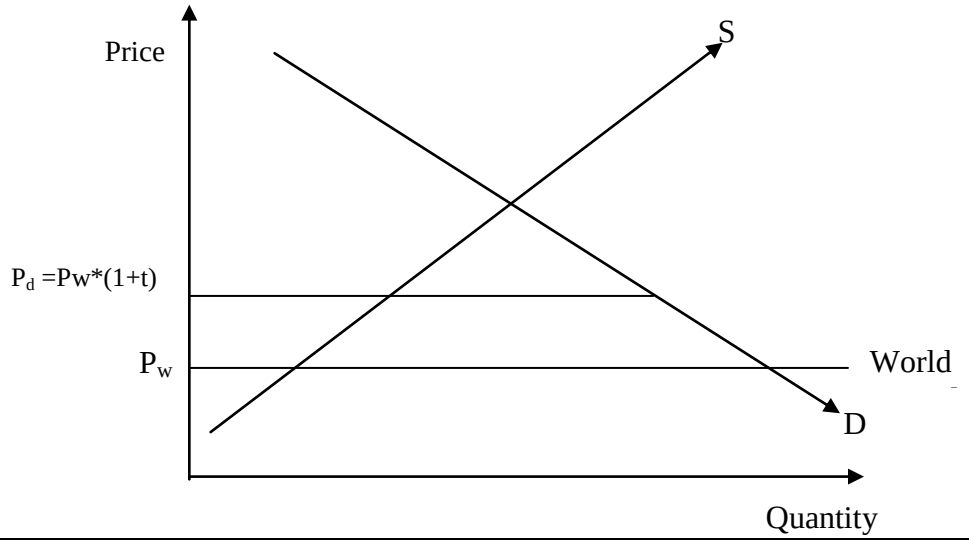
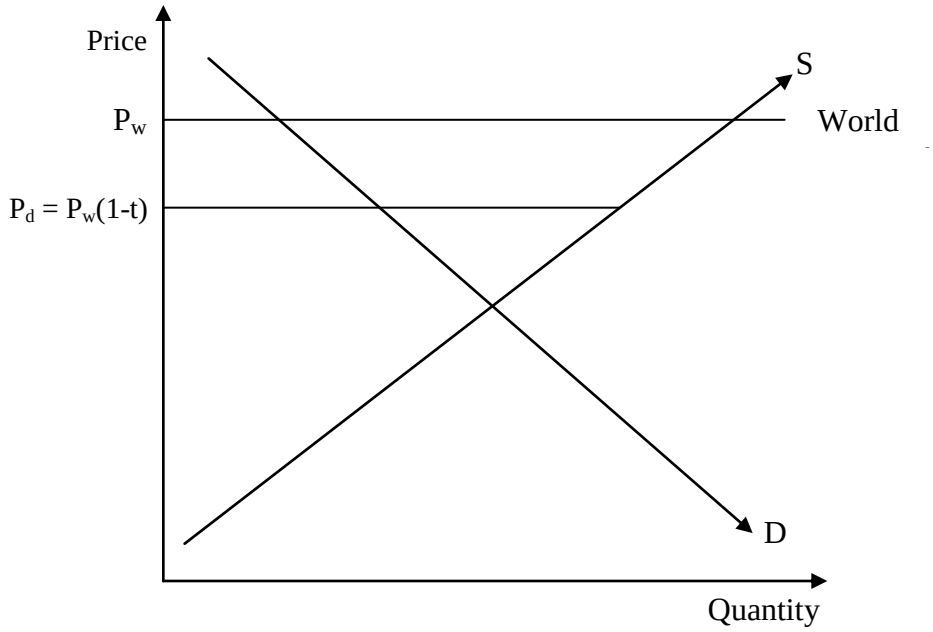


Figure: Distortion caused by an Export Tax



The market of foreign exchange is a derivative of the markets for imports and exports. Behind the domestic demand for foreign currency is the demand for imports, which in turn depends upon the domestic demand and supply of importable goods. Thus the demand for imports is translated into the demand for foreign exchange by importers. Similarly, behind the domestic supply of foreign currency is the supply of exports which depends on the domestic supply and demand of exportable goods. Any distortions such as import duties, value added tax, export tax or subsidy or quantitative control in the markets of importable and exportable goods will distort the demand or supply of foreign currency.

Accounting for the Foreign Exchange Externality into Economic Analysis

If a project requires foreign exchange in order to purchase imported inputs, the increased demand would bid up the real price of foreign currency. This higher price would discourage other users of foreign currency on one hand and would stimulate some producers (exporters) to generate more of foreign exchange on the other. Just as in the case of taxes and subsidies on goods and services, the tax and tariff distortions create a wedge between the value of a unit of foreign exchange to the importers and exporters and the marginal cost or benefit of that unit. For importers the value of a unit of foreign exchange will be different from the marginal cost to the country of earning that unit of foreign exchange. Again, for exporters the value of a unit of foreign exchange will differ from the total value of economic resources earned by the economy from the export.

When there are substantial import tariffs in the country, the economic price of a unit of foreign exchange would be higher than its market value. This difference accounts for the externality and is referred to as foreign exchange premium. This foreign exchange premium has to be added to the financial values to arrive at the economic values of traded inputs and outputs. The methodology for the estimation of this premium is presented in appendix A.

Economic Benefits Including Externalities

In order to estimate the economic benefit of a project, its overall impact on the economy is examined taking into consideration the externalities that are present. As outlined above, in the presence of the externality, the social demand and the social supply are different from the private demand and the private supply respectively.

MPC = Marginal private cost

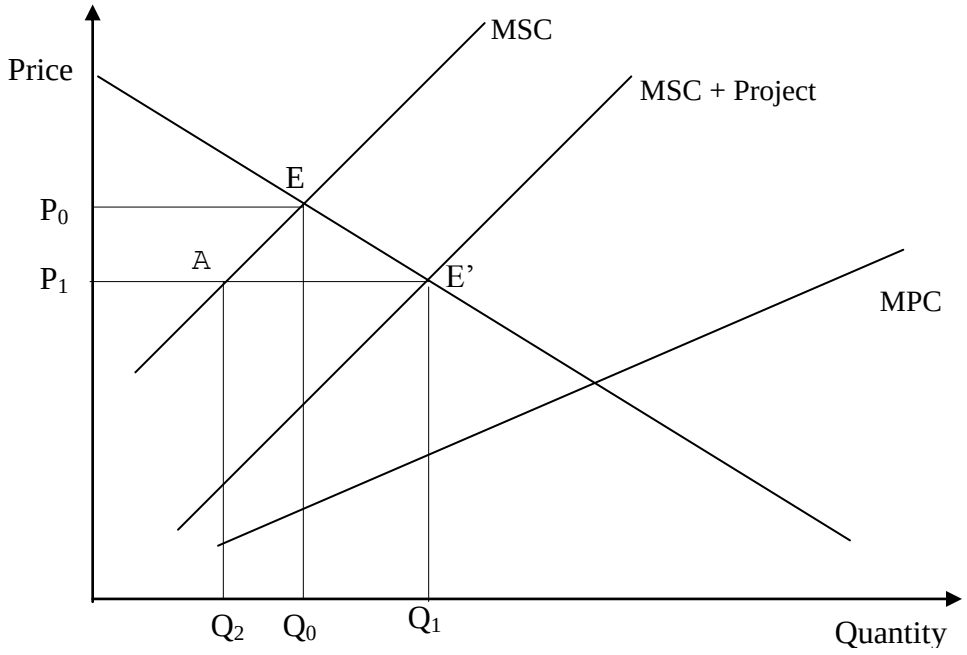
P_0 = Price before project

MSC = Marginal social cost

P_1 = Price after project

This is illustrated in figure below. In the presence of an externality that creates a divergence between the social value and the marginal cost, it is the social cost or social benefit curve that has to be taken into account in estimating the benefit of the output of a project or the cost imposed by its use of an input. Before the project, the social equilibrium is at E with optimal quantity Q_0 and price P_0. With the project, the price is P_1 and quantity is Q_1. There is a higher quantity in the market at a lower price. More consumers can enjoy the product and therefore the benefit to consumers has increased by EE' Q_1 Q_0. On the other hand, at a lower price, other producers cut back their production to Q_2 and some resources (EA Q_2 Q_0) are released to the economy that can be used for other purposes. Thus the total economic benefit of the project is the sum of additional benefit to consumers and the saving of resources to the economy due to the project, EA Q_2 Q_1 E'.

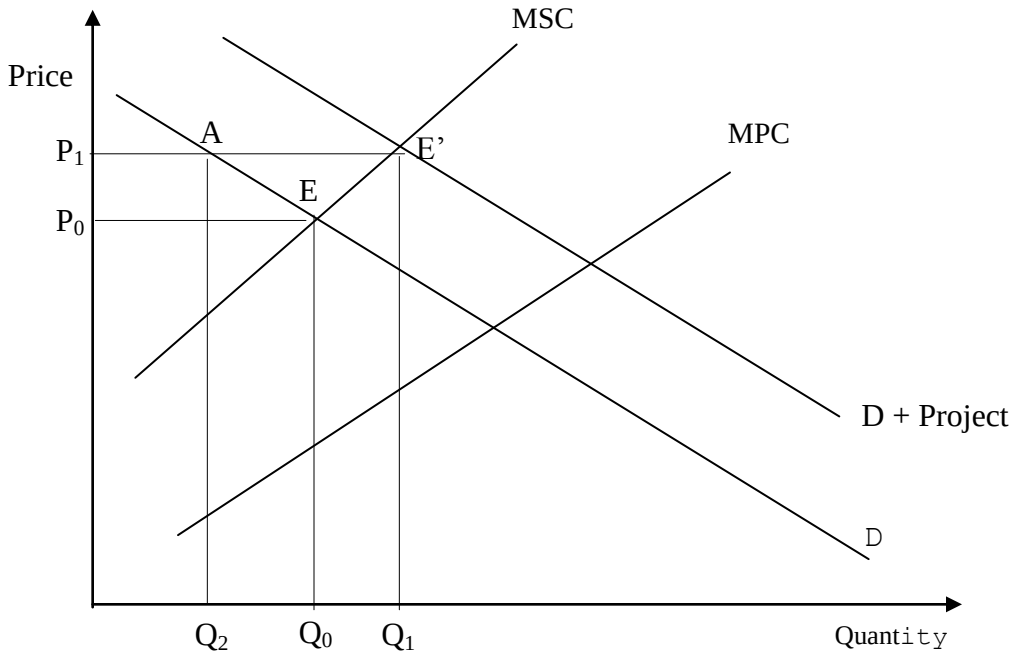
Figure



Economic Costs Including Externalities

The estimation of economic costs due to use of an input by a project may be done in a way that is similar to estimating the benefits. The equilibrium in the market of the input in the presence of externality is E with an optimal quantity Q_0 and price P_0. When the project uses this input in its production process, the demand moves out and the new equilibrium is at E' with quantity Q_1 and price P_1. Some new producers begin additional supply of the input because of the higher price and the cost of these resources to the economy is EE' Q_1 Q_0. Also, because of an increase in price of the input, some other consumers are pushed out of the market and the benefit foregone is EA Q_2 Q_0. Thus the total economic cost of project in the presence of an externality is the sum of these two costs and equals EA Q_2 Q_1 E'. This is illustrated in figure below.

Figure



MPC = Marginal private cost

MSC = Marginal social cost

P_0 = Price before project

P_1 = Price after project

Economic Externalities in the Capital Market and the Labor Market

The distortions in the capital market in the form of taxes and subsidies on return to savings (personal income taxes) and investment (property tax, corporate income tax) cause a divergence between the financial cost of capital (financial discount rate) and the Economic Opportunity Cost of Capital (EOCL or the economic discount rate) which is to be used for applying the investment criteria while conducting economic analysis of a project. The methodology for estimation of opportunity cost of capital is presented in appendix B.

Similarly, there are distortions in the labor market (income taxes, minimum wages) that create a distortion between the financial wage and the economic wage. While the market wage rate is used in conducting financial analysis of a project, the economic cost of labor has to be used in economic analysis. The methodology for estimating the economic cost of labor (EOCL) is presented in appendix C.

Annex IV

Different Types of Externalities and Accounting for Them in the Economic Analysis

The various externalities that one may often come across in appraising a project are described in table below (middle column). Also the relationship between the financial analysis and the economic analysis is summarized in this table. Column 1 presents the itemized incremental expected cash flows from the perspective of all investors. The bottom line for the financial analysis is measured by the NPV of the incremental expected net cash flows to *total* capital discounted by the private discount rate, i.e., the weighted average cost of capital (WACC) for that project.

Column 2 lists the various adjustments and externalities that need to be made to the financial analysis in order to turn it into an economic analysis. The adjustments account for any change in consumers' surplus and/or economic rent.

Column 3 includes the estimates of incremental economic benefits and costs. There are two ways of achieving these estimates, namely: (a) use Harberger's three principles or postulates of willingness to pay, supply price, and "a Dinar is a Dinar" to measure economic benefits and costs directly, or (b) add the appropriate adjustment or externality to the corresponding financial cash flows to measure economic benefits and costs indirectly. The economic externality associated with each of the cash flow items is simply the difference between the economic price and market price of that item

For example, cash receipts and expenditures on materials, machinery and equipment in table below are divided into those arising from the sale and purchase of *tradable* and *non-tradable* commodities. The sale and purchase of *tradable* commodities will generate tariff and tax externalities as well as a foreign exchange externality. The latter is due to distortions in the markets for the country's all *tradable* and *non-tradable* commodities, not just in the market for the project's inputs and output that cause the economic opportunity cost of foreign exchange (economic exchange rate) to differ from the market exchange rate. The effect of adding the foreign exchange externality to the domestic value of the incremental foreign exchange generated by either a project's exports or its import substitution, as in approach (b) above, is equivalent to valuing the incremental foreign exchange by the economic exchange rate, as in approach (a). Similarly, the foreign exchange externality should be added to the domestic cost of foreign exchange required for tradable materials, machinery and equipment.

Using approach (a), the economic benefit of a project's *non-tradable* output is measured by the economic value of any incremental industry output and consumption (based on willingness to pay) and/or by the economic value of any resources (based on their supply price) released by other firms in the industry that are forced to reduce their output or shut down in response to a project's increased output. Let us say that a

project's output just creates incremental industry output and consumption. If the output is subject to a sales tax such that the price paid by consumers inclusive of the tax is higher than the price received by producers, then the economic value of any incremental output (based on willingness to pay) will include the incremental sales tax revenue (i.e. approach (a)). The alternative approach (b) recognizes that the sales tax is a market distortion that creates a sales tax externality that should be added to the private sector cash receipts to measure a project's economic benefits.

Table

An Overview of Financial Cash Flows, Economic Externalities, & Economic Benefits/Costs

NPV of Incremental Private Sector Financial Cash Flows	NPV of Economic Externalities and Adjustments	NPV of Incremental Economic Benefits and Costs
1. Incremental Cash Receipts		**1. Incremental Economic Benefits**
a. Tradable Commodities (+)	a. Tariff and Tax Externalities (-); Foreign Exchange Externality (+)	a. Economic Value of Tradable Output (+)
b. Non-tradable Commodities (+)	b. Additional Sales/Excise Tax Revenues (+); Changes in Consumers' Surplus and Economic Rent (+ or -)	b. Economic Value of Non-tradable Output (+)
2.Incremental Cash Disbursements		**2. Incremental Economic Costs**
a. Materials, Machinery and Equipment (including On-site Infrastructure, but Excluding Construction Labor)		
i. Tradable (-)	a.i. Tax and Tariff Externalities (+); Foreign Exchange Externality (-)	a.i. Economic Cost of Tradable Materials and Equipment (-)
ii. Non-tradable (-)	a.ii. Changes is Sales/Excise Tax Revenue (+ or -)	a.ii. Economic Cost of Non-tradable Materials, Equipment (-)
b. Construction and Operating Labor (-)	b. Labor Externality (+) (including Economic Rent and Economic Benefits from Multiplier Effects)	b. Economic Opportunity Cost of Construction and Operating Labor (-)
c. Income Taxes (-)	c. Income Taxes (+)	0
d. Property and Municipal Taxes (-)	d. Property and Municipal Taxes (+)	0
e. Other Business Taxes (-)	e. Other Business Taxes (+)	0
f. Public Utilities and Services (-)	f. Adjustment for Non-efficient Pricing of Utilities and Services (+ or -)	f. Economic Cost of any Incremental Resources Used (-)
g.	g. Adjustment for Economic Cost of Off-Site Infrastructure (-)	g. Economic Cost of Off-Site Infrastructure (-)
h.	h. Externality from Foreign Financing (+ or -)	h. Externality from Foreign Financing (+ or -)
i.	i. Environmental Externality (+ or -)	i. Environmental Externality (+ or -)
j.	j. Basic Needs Externality (+)	j. Basic Needs Externality (+)
k.	k. Other Externalities (+ or -)	k. Other Externalities (+ or -)
NPV of Net Cash Flow to Total Capital Discounted at Private Discount Rate (PDR)	NPV of Economic Adjustment Discounted at the Economic Discount Rate	NPV of Net Economic Benefits Discounted at the Economic Discount Rate (EDR)

The economic costs of the resources required by a project are measured by their economic opportunity cost since these scarce resources would have been involved in alternative

activities in the absence of a project. When the resources would otherwise have been employed, then their opportunity cost is measured by the willingness of other users to pay for their use in their forgone employment. When the resources have to be attracted to this industry from elsewhere in the economy, then their supply price becomes the economic opportunity cost. And when resources are drawn from both other employment and other activities, then the economic opportunity cost is a weighted average of the willingness to pay in the forgone employment and the minimum supply price.

As on the output side, any difference between the economic opportunity costs of the resources employed by a project and their market cost, can be considered an economic externality. Hence, there are two ways in which to estimate the economic opportunity cost of a project's inputs, namely: (a) use Harberger's principles of willingness to pay, supply price, and "a Dinar is a Dinar" to measure economic costs directly, or (b) estimate the appropriate adjustment or economic externality and add it to the corresponding financial cash outflows. The adjustment that might have to be made in this case is to include any economic rent that is earned by the owners of an input; this rent is comparable to any change in consumers' surplus on the output side.

Taxes paid by a firm as a result of a project such as income tax, property and municipal tax and other business taxes are a private cost, but not necessarily a cost to the economy. This is why items (c), (d) and (e) under cash disbursements have an economic cost of zero.

In addition to these immediate externalities there is a broader set of external effects that also has to be taken into account in the economic analysis.

- The financial price of utilities is often fixed by the government and it may be quite different from its economic value.

- The firm proposing a project considers only the private cost of any required on-site infrastructure whereas the economic analysis should include the economic cost of both the on-site and off-site infrastructure, such as improved transportation facilities or the added capacity of public utilities.

- Foreign debt or equity financing may generate added economic benefits or costs not included in the financial appraisal.

- A project may cause increased environmental damage which is excluded from the private financial analysis, but should be included as an economic cost.

- A project may create a basic needs externality if it improves the provision of basic needs to the most needy segments of society.

The estimates of incremental economic benefits and costs should be discounted by an economic discount rate. Since economic benefits and costs can estimated by adding economic externalities to their corresponding financial cash flows, both the externalities and the financial cash flows have to be discounted by the economic discount rate as well.

Appendix 2: Estimation of Economic Prices or Tradable Goods and Services

Introduction

Projects affect economic well-being in a country. To analyze the economic worth of a project it is important to know the true economic values of its inputs and outputs. In order to get these true economic values we need to know:

1. Whether the goods are tradable or non-tradable;
2. How distortions such as tariffs, taxes, and subsidies create a wedge between economic and financial values of both tradable and non-tradable project's inputs and outputs;
3. How the transportation and handling costs of inputs and outputs affect the true economic values of goods and services used and produced by a project;
4. How distortions also create a divergence between the market and the economic exchange rates, the financial and economic costs of capital and financial and economic wage rates.

This chapter explains the above concepts and shows in detail how to obtain the true economic prices of tradable goods and services.

Project appraisal emphasizes the difference between the financial and economic values of inputs and outputs particularly when distortions exist in either the demand or supply side of markets for goods and services. As such, the concept of a conversion factor (CF), defined as the ratio of the economic price to the financial price, plays an important role in looking at the financial and economic costs or benefits of a project. For a given good or service, the term Commodity Specific Conversion Factor (CSCF) is used in lieu of the general term of conversion factor (CF). If we know the conversion factor specific to project's inputs and outputs in addition to the economic costs of capital and foreign exchange, we can easily translate the financial appraisal of a project into its economic valuation. While commodity specific conversion factor values and economic cost of labor may be different when calculated at project sites, economic parameters such as economic cost of capital and foreign exchange are national parameters that remain constant, at given time, across projects in the overall economy.

If there are no distortions in the supply and demand market of a commodity, then the CSCF will simply be 1 because the economic and financial prices are the same. If the market for foreign exchange is distorted, the market exchange rate (E^m) or the official exchange rate (OER) will not accurately reflect the economic value of a unit of foreign exchange in relation to the domestic currency. Thus, it is essential to make an adjustment for the divergence between the market or official price of foreign exchange and its economic price, also referred to as the economic exchange rate (E^e) or sometimes as the shadow exchange rate (SER). For a detailed discussion on how to calculate E^e please refer to Appendix A.

In the case of a tradable commodity, it is important to make a distinction between economic values at the port and at the project site. This difference is due to the economic costs of domestic handling and transportation to move the commodity from port to the project site or vice versa. The later sections explain how to estimate *the economic price of tradable goods at the port* by adjusting for

trade and foreign exchange distortions. As mentioned earlier several distortions such as tariffs, taxes and subsidies create differences between the economic and the financial price of a tradable good. Economic prices are those that account for the real resources consumed or produced by the project and hence do not include tariffs, taxes or subsidies as these are merely transfers between the consumers, the producers and the government all within the same economy. Financial prices are market prices, which naturally incorporate all the tariffs, taxes and subsidies. This section, therefore, also clarifies how to account for the effect of Foreign Exchange Premium (FEP)[26] when estimating economic prices in domestic currency for an importable and an exportable good.

Tradable and Non-Tradable Goods

A good or service is considered tradable when an increase in demand (supply) by a project does not affect the amount demanded (supplied) by domestic consumers (producers). The increase in demand (supply) by a project is eventually reflected as an increase/decrease in imports or a decrease/increase in exports depending on whether the project is demanding or supplying the importable or exportable commodity. Importable goods include imported goods and all goods produced and sold domestically that are close substitutes for either the imported goods or potentially imported goods. Exportable goods include exported goods and domestic consumption of goods of same type or close substitutes for the exported goods. An increase in demand for an importable commodity by a project results in an increase in demand for imports. An increase in demand for an exportable commodity by a project results in a reduction in exports. Alternatively, when the project produces an importable commodity, there will be a reduction in imports; when the project produces an exportable, there will be an increase in exports.

A commodity or service is "non-tradable" from a country's point of view if its domestic price lies above its FOB export price or below its CIF import price[27]. The international transportation cost may be very high compared to the value of the product so that no profitable trade is feasible. Alternatively, an importable good will become non-tradable if it receives such a high level of protection in the form of trade quotas or prohibitive tariffs that no import transactions will take place.

[26] Foreign Exchange Premium (FEP) is the percentage difference between the Economic Exchange Rate and the Official Exchange Rate. Thus, it is a measure of the divergence between the Economic Exchange Rate and the Official Exchange Rate due to distortions in the markets for tradables. Note that the market for foreign exchange is derived from the demand and supply of a country's tradable goods. Numerically, FEP = (E^e/OER)-1.

[27] FOB price implies "free-on-board" export price and it is the price of a good at the border before it is shipped abroad. Thus, it includes transportation and handling in moving the good to the port. CIF price implies "costs of insurance and freight" import price and it is the price at the border before any transportation and handling is incurred to move the good to the project site.

Estimation of Economic Prices at the Port: Adjusting for Trade Distortions and Foreign Exchange

The difference between the financial costs of a tradable commodity at port and at project site is the financial cost of transportation and handling between the port and the project. Likewise, the economic price of a tradable at port will also differ from the economic price at project site because of the economic cost of handling and transportation between port and project being different from the financial cost.

The economic cost of an importable input or the benefit from an import substitute output is measured by its CIF price. Similarly, the economic benefit from an exportable output or the economic cost of an exportable input is measured by its FOB price. When these prices are quoted in units of foreign exchange they directly measure economic costs or benefits at the port. However, when these are to be expressed in units of domestic currency, they have to be multiplied by the economic exchange rate. That is to say, they have to be not only multiplied by the official exchange rate but the foreign exchange premium component also has to be added to reflect the true economic values in domestic currency, at the port[28].

CIF and FOB prices are economic values of traded goods at the country's port when expressed in units of foreign currency. It is possible to calculate economic values of traded goods expressed in units of domestic currency including the foreign exchange premium. If the CIF/FOB price is known, then multiplying the CIF or FOB with the official exchange rate and thereafter adding the foreign exchange premium effect will give us the desired economic value in domestic currency including the foreign exchange premium (FEP). On the other hand, if only the domestic financial price (expressed in units of domestic currency and including distortions) at the port is known, then to arrive at the final economic value in domestic currency including the FEP effect, we carry out a two-stage adjustment. We first remove the distortions built into the financial price of the good, the distortions being the taxes and subsidies on that particular good and then adjust the undistorted financial price with the FEP. This two-stage adjustment allows us to calculate the economic price of a good in the domestic currency including the FEP effect[29].

Examples Showing the Calculation of Financial and Economic Prices

The following three examples show how to calculate financial and economic prices at the port.

Example 1: The Import of Pneumatic Tires (with an import duty)
(The figures in this example are assumed for illustrative purposes only)

Consider a project that imports pneumatic tires into the Iraq. There is a 30% tariff on imports of pneumatic tires and a 10% value added tax (VAT). The first steps in

[28] Numerically, $P^e=P^w*OER*(1+FEP)$, where P^e= economic value; P^w= world financial price, either CIF or FOB (e.g.in US$); OER= Official Exchange rate Iraqi Dinars/$); FEP= Foreign Exchange Premium.

[29] Numerically, the economic price adjusted for foreign exchange premium, $P^e = (P^d * CSCF) * (1 + FEP)$, where P^d = domestic financial price at the port; CSCF = commodity-specific conversion factor at port.

calculating the financial and economic prices of tires at the port are as follows:

CIF Price of Tires
$40
Import Tariff
30% of CIF
Sales Tax or VAT
10% of (CIF + Tariff)
Official Exchange Rate (OER)
Iraqi Dinars 45/US$

Tariff 30%
0.3*40 = $12
Price of Tires with Tariff
$40 + $12 = $52
Sales tax or VAT 10%
0.1*52 = $5.20

Financial Price of Tires in foreign currency
= CIF + Tariff + VAT
= $40 + $12 + $5.20
= $57.20

Economic Price of Tires in foreign currency
= CIF Price
= $40

Financial Price of Tires in domestic currency
= 57.20 * Iraqi Dinars 45
= Iraqi Dinars 2574

Economic Price of Tires
Before adjustment for
= 40 * Iraqi Dinars 45
FEP (in domestic currency)
= Iraqi Dinars 1,800

The economic price in domestic currency calculated above has been derived as the product of the CIF price and the market exchange rate. This calculation does not take into account the fact that trade subsidies and taxes in the economy (such as import tariffs and export taxes) have an overall effect on the market of foreign exchange and, hence, cause the economic price of foreign exchange to differ from the market or official price of foreign exchange. Consequently, there is a foreign exchange premium. If we assume the economic exchange rate (E^e) to be Iraqi Dinars 50/US$1, we can account for the effect of the FEP in the following manner:

Economic exchange rate (E^e)
= Iraqi Dinars 50/ US$1
Foreign Exchange Premium (FEP)
= (E^e / OER) - 1

= (50 /45) - 1

= 0 .111

Economic Price of Tires in domestic currency,
after first step (above)
= Iraqi Dinars 1,800

Economic Price of Tires in domestic currency,
including effect of FEP:
= 1,800 * (1 + FEP)
= 1,800 * (1 + 0.111)
= Iraqi Dinars 2000

Conversion Factor (E^e / E^m)
= 2000/2574 = 0.777

The economic price of a pneumatic tire at the port in domestic currency taking into account the effect of the FEP is, therefore, Iraqi Dinars 2,000.

To summarize, although we have first calculated financial prices in domestic currency in this example, the economic value in domestic currency at the port including the FEP effect can be calculated directly from the CIF price as follows:

Economic Price of Tires in domestic currency
= [CIF (in $) * OER]* (1 + FEP)
with the FEP
= $40 * 45/$ * (1.111)

= Iraqi Dinar 2,000

If we were starting with the financial price in domestic currency, we could calculate the economic price as follows:

Economic Price of Tires
in domestic currency
= [P^d * (1 + FEP)] / [(1 + Tariff)*(1+ VAT)]
with the FEP effect
=(2574 * 1.111) / [(1.3 * 1.1)]
= 2,000

Example 2: The Export of Shoes (with an export subsidy)

(The figures in this example are assumed for illustrative purposes only)

Consider a project in Iraq that exports shoes. The FOB price at the port is $200 per dozen pair of shoes. Although there is no actual subsidy on shoes production in the country now, for illustrative purposes we will assume a 10% subsidy in this example. This will cause the domestic market price to rise above the FOB price. The first steps in calculating the financial and economic prices of shoes are as follows:

FOB Price
= $200
Subsidy (K)=10% FOB
= 0.1*200 = $20

Financial Price of Shoes
= FOB + K
in foreign currency
= 200 + 20 = $220

Economic Price of Shoes = FOB Price = $200
in foreign currency

Financial Price of Shoes
= 220 * Iraqi Dinars 45 = Rs. 9,900
in domestic currency

Economic Price of Shoes in domestic
= 200 * Iraqi Dinars 45
= Iraqi Dinars 9,000
currency before FEP adjustment

The economic price of shoes calculated above is the product of the FOB price in foreign currency and the official exchange rate. This approach does not take into account the fact that trade subsidies and taxes in the economy have an overall effect on the market for foreign exchange and, hence, cause the economic price of foreign exchange to differ from the market price of foreign exchange. Consequently, there is a foreign exchange premium. We account for the effect of the FEP in the following manner:

Economic exchange rate (E^e)
= Iraqi Dinars 45/US$
Foreign Exchange Premium (FEP)
= E^e/OER - 1
= 50/45 - 1
= 0.111

Economic Price of Shoes in domestic currency,
after first step (above)
= Iraqi Dinars 9,000

Economic Price of Shoes in domestic currency,
including effect of FEP:
= 9,000 * (1 + FEP)
= 9,000 * (1 + .111)
= 10,000

Conversion Factor (E^e / E^m)
= 10000/9900 = 1.0101

The economic price of shoes at the port in domestic currency, taking into account the effect of the FEP is, therefore, Iraqi Dinars 10,000.

To summarize, although we have first calculated financial prices in domestic currency in this example, the economic value in domestic currency at the port including the FEP effect can be calculated directly from the FOB price as follows:

Economic Price of Shoes
=[FOB (in $) * OER] * (1 + FEP)
in domestic currency
= $200 * Iraqi Dinars 45/$ * (1.11)
with the FEP effect
= Iraqi Dinars 10,000

If we were starting with the financial price in domestic currency we could calculate the economic price as follows:

Economic Price of Shoes
in domestic currency
= [P^d * (1 + FEP)] / (1 + Subsidy)
including FEP
= (9,900 * 1.11) / (1 + 0.1)
= 10,000

Example 3: The Export of Garments (with an export tax)

(The figures in this example are assumed for llustrative purposes only)

Consider a project that exports men's and women's outer garments. The FOB price at the port is $800 per hundred pieces of garments. Although there is no actual export tax on garments export in the Iraq now, for illustrative purposes we will assume an export tax in this example. Assume there is a 5% export tax on all garments exports from Iraq. This will cause the domestic market price to fall below the FOB price. The first steps in calculating the financial and economic prices of garments are as follows:

FOB Price
= $800
Export tax (t_x) = 5% FOB
= 0.05*800 = $40
Financial Price of Garments
= FOB - t_x
in foreign currency
= 800 - 40 = $760
Economic Price of garments = FOB Price
= $800
in foreign currency
Financial Price of garments
= 760 * Iraqi Dinars 45
= 34,200
in domestic currency

Economic Price of garments = 800* 45
= Iraqi Dinars 36,000
in domestic currency before FEP adjustment

The economic price of garments calculated above is the product of the FOB price in foreign currency and the official exchange rate. This approach does not take into account the divergence between the economic price of foreign exchange and the market price of

foreign exchange, that is, the foreign exchange premium. We account for the effect of the FEP in the following manner:

Economic exchange rate (E^e)
= Iraqi Dinars 50/US$
Foreign Exchange Premium (FEP)
= E^e/OER - 1
= Iraqi Dinars 50/45 - 1
= 0.111

Economic Price of garments in domestic currency,
after first step (above)
= Iraqi Dinars 36,000

Economic Price of garments in domestic currency,
including effect of FEP:
= Iraqi Dinars 36,000 * (1 + FEP)

= Iraqi Dinars 36,000 * (1 + .111)

= Iraqi Dinars 40,000

The economic price of garments at the port in domestic currency, taking into account the effect of the FEP is, therefore, Iraqi Dinars 40,000.

*To summarize, a*lthough we have first calculated financial prices in domestic currency in this example, the economic value in domestic currency at the port including the FEP effect can be calculated directly from the FOB price as follows:

Economic Price of garments
= [FOB (in $) * OER] * (1 + FEP)
in domestic currency
= $800 * Iraqi Dinars 45/$ * (1.111)
with the FEP effect
= Iraqi Dinars 40,000

If we were starting with the financial price in domestic currency we could calculate the economic price as follows:

Economic Price of Garments
in domestic currency
= [P^d * (1 + FEP)] / (1 – tax)
including FEP
= (Iraqi Dinars 34,200 * 1.11) / (1 - 0.05)

= Iraqi Dinars 40,000

Estimating Commodity Specific Conversion Factors

As explained earlier, economic distortions drive a wedge between financial and economic prices of goods and services. It is convenient to determine the conversion factor of a commodity at port. But such a conversion factor excludes the economic cost of domestic handling and transportation from port to project site and vice versa.

Recall that the estimation of economic prices for tradable goods makes use of the Foreign Exchange Premium (FEP). Since a commodity's CSCF is its economic price divided by its financial price, the CSCF for tradable goods at the port (i.e., before considering transportation and handling costs), can then be calculated as follows:

1. For importable goods at the domestic currency, given no quantitative restrictions:
$CSCF_d$ (port) = (1 + FEP)/ {(1 + T)*(1 + T_1)*(1 + T_2)...}
where:
T = rate of import tariff
T_1, T_2, etc. = other taxes, sales, excise, and value added taxes

2. For exportable goods at domestic currency, given no quantitative restrictions:

$$CSCF_d \text{ (port)} = (1 + FEP)/\{(1 - t_x)(1 + VAT)\}$$

where

t_x = export tax rate[30]

VAT = value added tax

Note: If a project is exempt from paying the VAT on any of its traded inputs, the financial price of this traded good will be lower than the financial price in a non-exempt case, which will cause the CSCF for that good to be higher.

Estimation of Economic Prices at the Project: Adjusting for Handling and Transportation Costs

Up to this point we have been discussing economic values of a commodity at the port. It is important to make a clear distinction between a commodity's value at port and a commodity's value at the project site. As explained below, a commodity's economic value will generally differ from one project site to another due to differences in handling and transportation costs.

The CIF price of an importable good and the FOB price of an exportable good give us the economic prices in foreign currency of an item at the port. There will, however, be additional costs of handling and transportation between the port and the location of the project. To estimate the economic cost of an importable input used by a project, the economic costs of domestic transportation and handling should be added to the economic price of this good.[31]

Alternatively, if we are evaluating the economic benefit of an exportable output produced by a project, the economic costs of domestic transportation and handling should be subtracted from the economic price at port to find the economic benefit of the output evaluated at the project site.

The handling and transport sectors use, in addition to labor, items such as petroleum products, cranes and lifts, and motor vehicles as inputs. As a consequence, the handling and transportation costs have both tradable and non-tradable components which may be taxed or subsidized. The economic costs of these items may, therefore, be significantly different from their financial prices. The following two examples show how handling and transportation costs affect the economic value of a commodity.

In a nutshell, following four cases arise in the estimation of economic benefit and cost of importables and exportables including costs of handling and transportation. In each case, first the financial cost or benefit is computed and then it is adjusted for distortions and foreign exchange premium to arrive at economic costs and benefits.

(1) Economic Cost of an Importable Used by a Project as an Input

Financial Cost of Imported input at the project site:

CIF at port

+ Tariff and Countervailing Duty if any

[30] An export subsidy would be entered as a negative tax.

[31] Economic values for transportation and handling are likely to be different from their market costs due to distortions in their respective input markets.

+ Port Charges Including Tax/subsidy
+ Freight including tax/subsidy from port to project site
Price paid at the Project site

The economic cost of the imported magnets will be:

CIF adjusted for Forex Premium
+ Economic Values of Port Charge
+ Economic Values of Freight from port to project

(2) Economic Benefit of an Importable Produced by a Project (Import Substitution)
Financial Benefit of production by the project equals costs savings to user units from not importing the materials minus the cost of transportation from the plant to the market or the user unit. The economic benefit is calculated from the financial benefit after adjusting for distortions and foreign exchange premium.

Thus financial benefits are:
CIF at importing port
+ Tariff
+ Port Charges Including Tax/subsidy
+ Freight and Insurance including tax/subsidy from port to market or user unit
Importer's Price
- Transport Charges from Mine to Power Plant
Financial Price at the site of the project

The economic benefit (price) of import substitution product produced by the project will be the economic value of the savings to the economy from not importing that product:

CIF Adjusted for Forex Premium
+ Economic Value of Port Charges
+ Economic Value of Freight and Insurance from port
- Economic Value of Transport Cost from project to user unit or the market

3. Economic Benefit of an Exportable Produced by a Project
Economic benefit of the exported items is estimated by first calculating its financial price (benefit) and then adjusting it for distortions and foreign exchange premium:

Financial Price of Exported item produced by the project:
FOB at the port
+/- Subsidy/tax
- Freight & insurance from project to port inclusive of tax/subsidy, if any
-Port Charges at the Port inclusive of tax/subsidy, if any
Price Received by the project

The Economic Benefit (price) of exported item will be:
FOB Adjusted for Forex Premium
- Economic Value of Freight and Insurance from project to port
- Economic Value of Port Charges

4. Economic Cost of an Exportable Used by a Project
Financial cost will be loss from not exporting plus transport cost from project to market or user unit. The economic costs will be computed from financial cost with adjustment for distortions and foreign exchange premium.

The financial cost of using exported item:
FOB at the port
- Port Charges inclusive of tax/subsidy if any
- Freight from project to port and Insurance inclusive of tax/subsidy if any
Price Received by the exporting unit
+ Freight and Insurance from exporting unit to market or project

Price paid by the project using the exported materials as input

The economic cost of the exported item used as input by the project will be:
FOB Adjusted for Forex Premium
- Economic Value of Port Charges
- Economic Value of Freight and Insurance from exporting unit to port
+ Economic Value of Freight and Insurance from exporting unit to project/ market

Below are two numerical examples of computing economic cost and benefit after adjusting for distortions, foreign exchange premium and costs of transportation and port handling.

Example 4: A Project Importing Pneumatic Tires
(These figures are assumed for illustrative purposes only)

Consider, once again, the imports of pneumatic tires. Suppose that the financial cost of handling exclusive of a 20% VAT is Iraqi Dinar 15 per tire; hence the financial cost of handling inclusive of tax is 15 * (1 + 0.20) = Iraqi Dinar 18 per tire. The financial cost of transportation from the port to the assembly plant (after taking into account a 10% subsidy) is Iraqi Dinar 9 per tire. The subsidy is expressed as a percentage of production costs. The financial and economic costs of a tire as an input to car assembly are calculated below:

Financial Cost at Assembly Plant = Financial Price at Port + Financial cost of Domestic Transportation + Financial Cost of Handling

= (Iraqi Dinar 2,574 + Iraqi Dinar 9 + Iraqi Dinar 18) = Iraqi Dinar 2,601

To obtain the final economic cost of a tire including transportation and handling, we begin with the economic price of a tire in domestic currency at the port as calculated in earlier section. After we adjust handling and transportation costs for their distortions and for the foreign exchange premium, we add the economic cost of handling and transportation to the economic price of a tire at the port to obtain the final economic cost of tires at the project site. It is assumed that transportation is made of 60% tradable content and handling is made of 80% tradable content, and hence, their 60% and 80% costs respectively are adjusted for FEP.

Economic Cost of Tire at the port (in domestic Currency including FEP) = Iraqi Dinars 2,000

Economic Cost of Transport = [Financial Cost / (1-Subsidy)] * (1 + 0.6*FEP)
= (Iraqi Dinars 9 / 0.9) * 1.07 = Iraqi Dinars 10.7
Economic Cost of Handling = [Financial Cost / (1+Tax)] * (1 + 0.8*FEP)
= (18 / 1.2) * 1.09 = Iraqi Dinars 16.35
Economic Cost of Tire at project site = 2,000 + 10.7+ 16.35= Iraqi Dinars 2027
Conversion factor including costs of transportation and handling = 2027/2601 = 0.779

Example 5: A Project Exporting Shoes
(These figures are assumed for illustrative purposes only)

Similar adjustments should be made for the export of shoes. Suppose that the handling charges exclusive of a 20% VAT are 56 Dinars per dozen shoes and the transportation charges from the factory to the port (after taking into account a 10% subsidy) are 80 Dinars per dozen shoes. Hence,

Financial Cost of Domestic Transportation = Iraqi Dinars 80

Financial Cost of Handling = Net-of-tax Cost of Handling * (1+Tax)

= Iraqi Dinars 56 * 1.2

= Iraqi Dinar 67.20

Financial Price at Factory Gate = Financial Price at Port - Financial Cost of Domestic Transportation - Financial Cost of Handling

= (Iraqi Dinar 9,900 – Iraqi Dinar 80 – Iraqi Dinars 67.20)

= Iraqi Dinars 9,752.80

To obtain the final economic value including transportation and handling, we begin with the economic price of shoes in domestic currency at the port (including the FEP component) as calculated in the previous section. We then adjust handling and transportation costs for their distortions and for the foreign exchange premium, and thereafter, we subtract the adjusted economic values of transport and handling from the economic prices of shoes to obtain the economic prices of shoes at the project site. It is assumed that transportation is made of 60% tradable component and handling is made of 80% tradable content, and hence, their costs are adjusted for FEP as follows.

Economic Cost of Shoes (in domestic currency including FEP)

= Iraqi Dinars 9,000*1.11 = Iraqi Dinars 10,000

Economic Cost of Transport = [Financial Cost / (1-Subsidy)] * (1 + 0.6*FEP)

= (Iraqi Dinars 80/ 0.9) * 1.07

= Iraqi Dinars 94.81

Economic Cost of Handling = [Financial Cost / (1+Tax)] * (1 + 0.8*FEP)

= (Iraqi Dinars 56/ 1.2) * 1.089

= Iraqi Dinars 50.80.

Economic Value of Shoes at project site = 10,000-94.81-50.80 = 9,854.40 Dinars

Conversion factor with transportation and handling costs = 9854.4/9752.80 = 1.0104

Appendix 3: Estimation of Economic Prices for Non-Tradable Goods and Services

Introduction

The three basic postulates for applied welfare economics are the fundamental foundations for the economic appraisal of investment projects. The first postulate states that the competitive demand price for a given unit of an item measures the value of that unit to the demander and is otherwise known as *the willingness to pay* by the demander. The second postulate states that the competitive supply price for a given unit of a good or service measures the value of that unit to the supplier or otherwise known as the concept of *opportunity cost*.[32] These economic prices of goods and services used for economic analysis are derived by adjusting the market or financial prices for distortions. Financial prices are used to construct financial cash flows and are essentially the starting point for conducting the appraisal of any project. Thus it is imperative to develop a strong financial analysis before proceeding to undertake the economic appraisal.

In the previous chapter we observed that the estimation of the economic costs or benefits for tradable goods associated with a project was based on the world demand or world supply price. However, in the case of non-tradable goods or services the estimation of the economic costs or benefits will be based on the weighted average of both demand and supply prices[33]. The framework for estimating the economic benefits and costs in undistorted markets is discussed first, followed by the methodology for the non-traded goods in the presence of distortions or externalities. This is followed by applications of the methodology, illustrated with examples.

Analyzing the economic benefits of an output produced by a project in an undistorted market

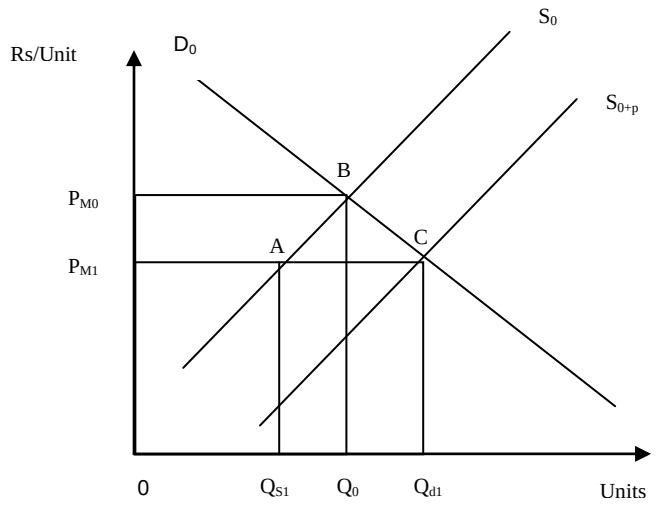
Consider the case of a new *project* and suppose our project produces a non-tradable good such as concrete. The figure below shows the supply and demand for this non-tradable good. The industry demand and supply curves prior to the introduction of the new project are denoted by D_0 and S_0 respectively. The new project produces a quantity Q_p and results in a shift in the industry supply curve from S_0 to $S_{0+P.}$ The additional supply by the project results in a drop in the market price from P_{m0} to P_{m1}. As a result of the decrease in price, consumers demand more and total consumption increases from Q_0 to $Q_{d1.}$ Also due to the decline in price, existing suppliers will cut back their production from Q_0 to Q_{s1} as some of them can no longer supply the same amount of the good at the new (lower) price P_{m1}. Q_p, the quantity produced by the project, equals the sum of the two quantities Q_0-Q_{d1} and Q_0-Q_{s1}.

[32] For a detailed discussion of the postulates, see Harberger, Arnold C., "Three Basic Postulates for Applied Welfare Economics: An Interpretive Essay", Journal of Economic Literature p. 785-97, September 1971.

[33] Asian Development Bank, Economics Office, "Guidelines For Economic Analysis of Projects" (1987), pp. 13-14.

Figure

Economic Benefits of a New Project in an Undistorted Market



Since the project sells its output at the new prevailing market price $P_{m1,}$ the gross financial receipts to the project are given by Q_p * $P_{m1.}$ To estimate the gross economic benefits of the project, we need to determine the economic value of the new consumption to the demanders, and the value of the resources released by existing suppliers. These values are estimated using the first two postulates as follows:

(i) The additional consumption is valued, according to the first postulate, by the demand price for each successive unit, or by the area under the demand curve (Q_0BCQ_{d1}).

(ii) The resources released by other producers are valued, according to the second postulate, by the supply price (resource cost) of each successive unit or by the area under the supply curve (Q_0BAQ_{s1}).

The gross economic benefits are given by the sum of the two areas above ($Q_{s1}ABCQ_{d1}$). It is important to emphasize that these benefits are gross. In other words, we have not netted from them the economic costs of producing these goods yet. Saying that a project has positive gross economic benefits is the economic equivalent of saying that a project has positive gross financial receipts. The positive gross benefits alone do not indicate whether the project is economically viable or not, the same way as positive gross financial receipts do not indicate whether the project is financially profitable or not.

It is worth noting that the gross economic benefits are equal to the sum of the financial receipts to the projects' owners ($Q_{s1}ACQ_{d1}$), plus the gain in consumer surplus ($P_{m0}BCP_{m1}$), less the loss in producer surplus ($P_{m0}BAP_{m1}$). In addition to the gross receipts to the project owners, consumers

gain due to the reduction in price and producers lose economic rents due to the reduction in price. From a distributional perspective, it is interesting to note that consumers' gain fully offsets the loss in economic rents to the existing producers. It may be noted that the changes in consumer and producer surplus result from the price drop.

It is often the case that the quantity produced by the project is relatively small compared to the size of the market and there is no change in the market price. In such a situation and given that we are operating in an undistorted market, the gross financial receipts will be equal to the gross economic benefits. In other words, there is no difference between the financial revenues generated by a project and its economic benefits to the society. The difference arises only when the project has a big impact on the industry.

Analyzing the economic cost of an input demanded by a project in an undistorted market (i)

This example demonstrates how the economic cost of a non-tradable item demanded by a project can be estimated(ii) using Harberger's postulates. The industry demand and supply curves without the additional demand by the new project are denoted by D_0 and S_0 respectively (Figure below). The new project demands a quantity Q_p and results in a shift in the industry demand curve from D_0 to D_{0+P}. The additional demand by the project results in a rise in the market price from P_{m0} to P_{m1}. As a result of the increase in price, existing consumers will cut back their consumption from Q_0 to Q_{d1} and producers will increase their production from Q_0 to Q_{s1} at the new (higher) price P_{m1}. Q_p, the quantity demanded by the project, equals the sum of the two quantities Q_0-Q_{d1} and Q_0-Q_{s1}.

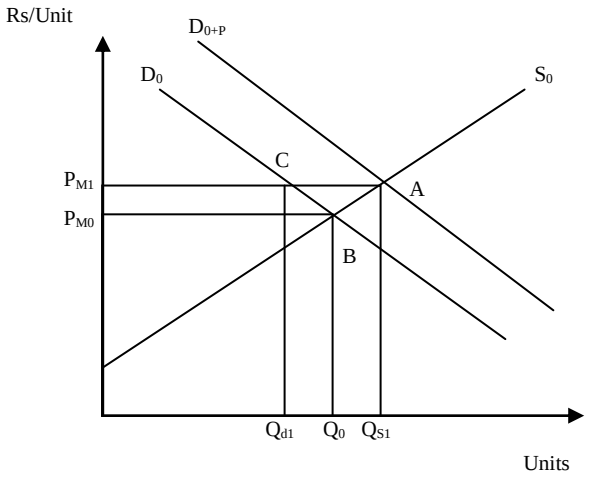
The project buys its requirement at the new prevailing market price $P_{m1,}$ and incurs a gross financial expenditure of $Q_p * P_{m1.}$ To estimate the gross economic costs of the input demanded by the project, we need to determine the economic value of the consumption that is foregone by the existing consumers, and the value of the additional resources utilized to accommodate the project's demand. These values are estimated using the first two postulates as follows:

The cutback in consumption is valued, according to the first postulate, by the demand price for each successive unit given up or by the area under the demand curve (Q_0BCQ_{d1}).

The additional resources used to accommodate the expansion in output are valued, according to the second postulate, by the supply price (resource cost) of each successive unit or by the area under the supply curve (Q_0BAQ_{s1}).

Figure

Economic Cost of an Input Demanded by a Project in an Undistorted Market



The gross economic cost for this input is given by the sum of the two areas above ($Q_{s1}ABCQ_{d1}$). By determining the economic cost of each input used by the project in a similar way, and the economic benefit of its output as outlined above, we will be in a position to determine the economic viability of the project by subtracting all economic costs from the gross economic benefits.

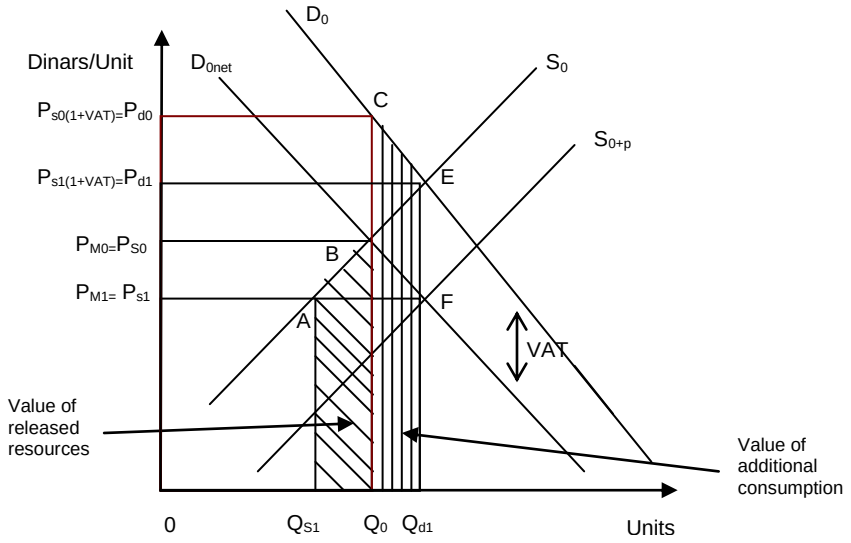
Economic Prices for Non-traded Goods in Distorted Markets

Analyzing the economic benefits of an output produced by a project in a distorted market

Suppose that the market for an industry's output is distorted by a value-added tax (VAT). The tax will drive a wedge between the maximum price that consumers are willing to pay for successive units of the good and the net of tax (effective demand) price they pay to the supplier. D_0 is the gross-of-tax (undistorted) demand curve that measures consumers' willingness to pay, and D_{0net} is the net-of-tax or effective demand curve that reflects the prices consumers are prepared to offer producers. D_{0net} lies below and to the left of the original curve, D_0, because the prices that consumers are prepared to offer to suppliers for successive units of the goods are now reduced by the amount of the VAT. The market-clearing price, P_{m0}, and quantity, Q_0, are determined by the intersection of the net-of-tax demand curve, D_{0net}, and the supply curve, S_0, as shown in Figure 1 below. While suppliers receive P_{m0}, which is equal to the resource cost of the marginal unit produced, consumers have to pay the VAT in addition to the market price P_{m0}. The price that consumers pay is P_{d0}.

Figure 1

Economic Benefits of a New Project in a Distorted Market



The above situation depicts the market without the new project. To determine the gross economic benefits of a new project in this market, we follow the same logic and mechanics used to estimate the economic value of a project's output in an undistorted market in earlier section. The new project produces a quantity Q_p and results in a shift in the industry supply curve from S_0 to $S_{0+P.}$ The additional supply by the project results in a drop in the market price from P_{m0} to P_{m1} and subsequently in the demand price from P_{d0} to P_{d1}. As a result of the decrease in price paid by consumers, they increase their consumption from Q_0 to $Q_{d1.}$ Also due to the decline in price, existing suppliers will cut back their production from Q_0 to Q_{s1} as some of them can no longer supply the same amount of the good at the new (lower) price P_{s1}. Q_p, the quantity produced by the project, equals the sum of the two quantities Q_{d1}- Q_0 and Q_0-Q_{s1}.

Since the project sells its output at the new prevailing market price P_{m1} (which is also equal to the supply price, P_{s1}), the gross financial receipts to the project are Q_p * $P_{s1.}$ To estimate the gross economic benefits of the project, we need to determine the economic value of the new consumption to the demanders, and the value of the resources released by existing suppliers. Following the first postulate, the value of additional consumption is measured by area under the undistorted (gross-of-tax) demand curve - the area Q_0BCEFQ_{d1}. Following the second postulate, the value of resources freed is measured by area under the supply curve - the area Q_0BAQ_{s1}. The gross economic benefits are the sum of these two areas: $Q_{s1}ABCEFQ_{d1}$.

Strictly speaking, we have concluded the estimation of the gross economic benefits of the project. It would be interesting, however, from a distributional perspective to

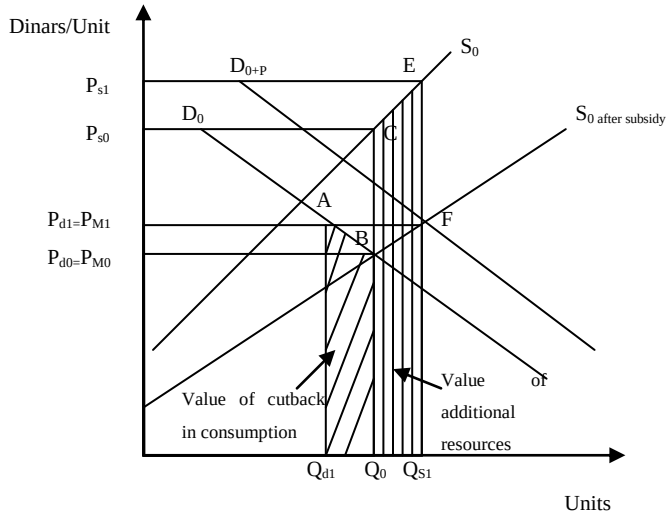
determine who has gained and who has lost as a result of the project. The gross economic benefits can be broken down into the gross receipts - net of VAT - to project owners ($Q_{s1}AFQ_{d1}$); the gain in consumer surplus ($P_{d0}CEP_{d1}$); the loss in producer surplus ($P_{s0}BAP_{s1}$) and gain in government tax revenues ($P_{d1}EFP_{s1}$- $P_{d0}CBP_{s0}$).

Analyzing the economic costs of an input demanded by a project in a distorted market

Suppose that the market for one of the project's inputs is distorted by a subsidy. The subsidy will drive a wedge between the true resource cost of the successive units of the good and the prices that suppliers are now willing to charge consumers (Figure 2 below). S_0 is the before-subsidy supply curve, which measures the true resource cost of the units produced; and $S_{0\ \text{after subsidy}}$ is the after-subsidy supply curve that reflects the prices that suppliers are prepared to charge consumers. $S_{0\ \text{after subsidy}}$ lies below and to the right of the original curve, S_0, because the prices that suppliers are willing to charge consumers for the successive units of the goods are now reduced by the amount of the subsidy they receive from the government. The market clearing price, P_{m0}, and quantity, $Q_{0,}$ are determined by the intersection of the after-subsidy supply curve, $S_{0\ \text{after subsidy}}$, and the demand curve, D_0, as depicted in the figure. While consumers pay P_{m0}, which is equal to their willingness to pay for the marginal unit consumed, producers will receive a government subsidy in addition to the market price, P_{m0}, they receive from consumers. The price per unit, that suppliers finally receive which also reflects the resource cost of the marginal unit, is P_{s0}.

Now suppose a project demands an input in this market. To determine the gross economic costs of this input, we follow the same logic and mechanics used to estimate the economic cost of an input in an undistorted market as outlined earlier. The new project demands a quantity Q_p and

Figure 2
Economic Cost of Input Demanded by a Project in a Distorted Market



results in a shift in the industry demand curve from D_0 to $D_{0+P.}$ The additional demand will bid up the market price of the input from P_{m0} to P_{m1} and subsequently the supply price from P_{s0} to P_{s1}. The increase in price will result in additional production by suppliers from Q_0 to Q_{s1}, and a cutback in consumption by the existing demanders from Q_0 to Q_{d1}. Q_p, the quantity demanded by the project, equals the sum of the two quantities $Q_0 - Q_{d1}$ and $Q_{s1} - Q_0$.

The economic cost of the project's input is measured by the value of the additional resources used to accommodate the expansion in production from Q_0 to Q_{s1}, and the value of the cutback in consumption by existing consumers. Following the second postulate, the value of additional resources used is measured by area under the before-subsidy supply curve - the area $Q_0BCEFQ_{s1.}$ Following the first postulate, the value of the postponed consumption by other demanders is measured by the area under the demand curve - the area Q_0BAQ_{d1}. The gross economic cost is the sum of these two areas: $Q_{d1}ABCEFQ_{s1}$.

For the distributional analysis of the project's demand, we can breakdown the economic costs of the input into its financial expenditures after subsidy paid by the project ($Q_{d1}AFQ_{s1}$); the loss in consumer surplus ($P_{d1}ABP_{d0}$); the gain in producer surplus ($P_{s0}CEP_{s1}$); and the loss in government expenditures on the subsidy ($P_{d0}BCP_{s0}$- $P_{d1}FEP_{s1}$).

In the following six sections, we apply the methodology that has been outlined above for estimating the economic prices for non-tradable goods and services under different types and combinations of distortions while illustrating each case with a numerical example. The procedure is to start with relatively straightforward cases for which economic prices and conversion factors can be easily estimated. For the more complicated situations that ensue, the methodology outlined below allows one to estimate the economic prices and conversion factors for non-tradable goods and services. However, these more sophisticated cases also have more demanding information requirements.

The analyses presented here are carried out under the assumption that despite the distortions that might exist in the form of taxes and subsidies, or that can be expressed as a tax or a subsidy in the markets for these non-tradable goods or services, there are no quantitative restrictions on the demand for or supply of these goods or services.[34]

The estimated economic prices are expressed in terms of domestic currency.

[34] For the evaluation of economic prices under conditions of rationing, price ceilings and monopoly, see Jenkins, Glenn P. and Arnold C. Harberger, Manual for Cost-Benefit Analysis of Investment Decisions, unpublished, (2005) pp. 9.14-9.24.

Case 1: A Project Producing A Non-Tradable Output with

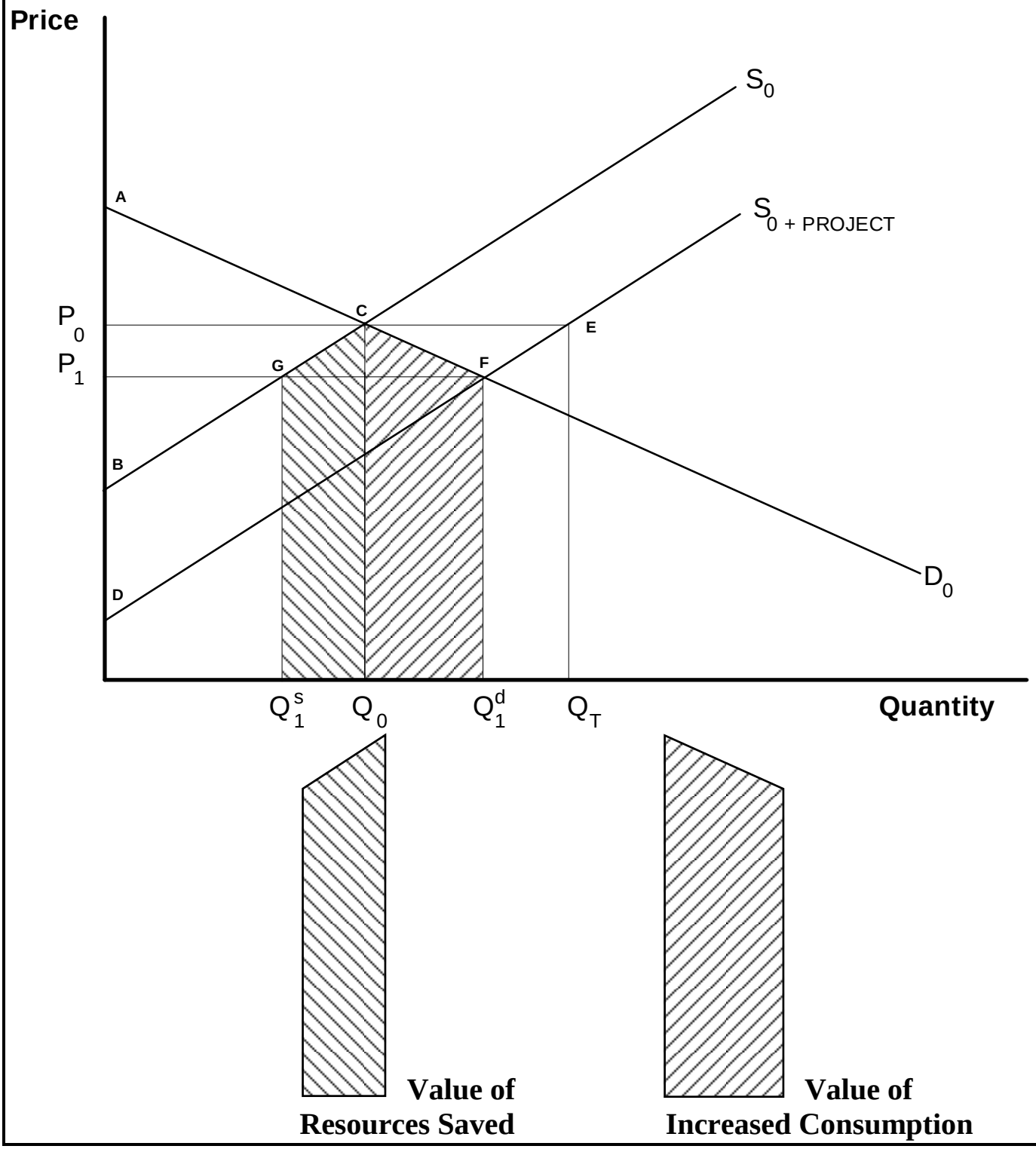
- No Distortions in the Market for that Output
- No Distortions in any of the Factors, Substitutes Or Complements of the Output, and where
- All Inputs Used in the Production of the Project's Output are Non-Tradable.

When a project produces a non-tradable output in a market where prices are competitively set, the price of the output will, in general, drop due to the additional supply of the project. At the new prices, the existing producers of the good are not willing to supply the same quantity of the good as before. As a result, they will cut back their production releasing resources for alternative uses in the economy. At the same time, the lower prices will induce additional consumption by the demanders of this good or service.

If there are no distortions in the markets of the substitutes or complements for a non-tradable output produced by a project, and if all the inputs used in its production are non-tradable and their markets are undistorted, the gross economic benefit (economic price) of the output will be the sum of the value of the released resources (as measured by the competitive supply curve - area $Q^s_1GCQ_0$ in Figure 3 below and the value to the demanders of the additional consumption as measured by their willingness to pay - area $Q_0CFQ^d_1$. In other words, the economic price per unit of the good or service produced will be a weighted average of the supply price per unit (P^s) and the demand price per unit (P^d).

The supply price per unit (P^s) is the average of the supply price before the implementation of the project (P^s_0), and the supply price after the project (P^s_1). Similarly, the demand price per unit is the average of the demand price before (P^d_0) and after (P^d_1) the implementation of the project.

Figure 3: Economic Benefits of Project Output (No Distortions)



The weighting reflects the responsiveness of consumers and suppliers to changes in prices of the non-tradable output. The weight applied to the demand side is the expected increase in the total consumption of the good or service, as a result of introducing the project's output, expressed as a proportion (W^d) of the project's sales. Similarly, the weight applied to the supply side is the decrease in the supply by non-project producers expressed as a proportion (W^s) of the project's sales. The sum of these weights must add up to one. To put it differently, it is necessary to determine what proportion of the quantity produced by the project replaces the cutback in the production of the existing (non-project) suppliers and what proportion of the project output adds to the existing supply in the market. Although the responsiveness and the relative weights can be formally calculated using elasticities, approximate values for these relative weights are usually arrived at by applying practical knowledge of the nature of demand and supply in the market.[35]

If it is anticipated that a drop in the output price will lead to an increase in the quantity demanded that is roughly equal to the cutback in the quantity supplied, then the weights can be considered approximately equal ($W^s = W^d = 0.5$). Alternatively, if it is anticipated that the supply response will be approximately twice the demand response, then the weight on the supply side of the market (W^s) will be equal to 0.67 and that on the demand side of the market (W^d) will be equal to 0.33.

The examples used throughout this chapter will demonstrate how the relative weights can be chosen for different goods and services. For practical purposes, one can limit the choices available to the following proportions:

1) $W^s = 0.67$ and $W^d = 0.33$
2) $W^s = 0.50$ and $W^d = 0.50$
3) $W^s = 0.33$ and $W^d = 0.67$

As subjective as the choice of these weights might seem, the estimation of economic prices using these weights tends to improve the accuracy of measuring economic values as compared to traditional approaches which place all the weight for adjustment on either the demand or the supply side of the market.

Estimation of Economic Prices

Algebraically, the economic price per unit of a non-tradable output produced by a project and expressed in the domestic currency (P^e) is represented as follows:

$$P^e = W^d * P^d + W^s * P^s$$

where $W^d + W^s = 1$

When no distortions apply to the market of a non-tradable good, the demand (P^d) and supply price (P^s) are both equal to the market price (P^m). In this case, if all inputs used in the production of that good have no tradable content, the estimation of the relative supply and demand weights is unimportant as the economic price per unit (P^e) is equal to the market price (P^m).

After estimating the economic price of the output, a commodity-specific conversion factor

[35] The weight on supply (W^s) = $\varepsilon^s / (\varepsilon^s - \eta^d * (Q^d/Q^s))$, and the weight on demand (W^d) = $-(\eta^d * (Q^d/Q^s)) / (\varepsilon^s - \eta^d * (Q^d/Q^s))$

where:
- ε^s = the price elasticity of supply
- η^d = the price elasticity of demand
- Q^d = the responsive quantity demanded in the market without the introduction of the project
- Q^s = the responsive quantity supplied in the market without the introduction of the project.

(CSCF) can be obtained by dividing the economic value per unit of output by its financial value:
$CSCF^s$ = Economic price per unit / Financial price per unit

This conversion factor will capture the degree of deviation between the financial supply price of the good and its economic price. One of the advantages of estimating commodity-specific conversion factors is their possible application to other projects producing the same output.

ustrative Example 1: A Project Providing Camp Site Nights

Consider the competitive market for camp sites in a beach resort where the quantities demanded and supplied are measured in terms of camp site nights per year. At present, and in the absence of distortions, the quantity supplied and demanded is 30,000 camp site nights per year at a price of 50 Dinars per night. Now introduce a project that will provide 2,000 camp site nights per year, and assume that the impact of the project output on the competitive market price is small.

P^s = the supply price per camp site night,
P^d = the demand price per camp site night,
P^m = the market price per camp site night,
Note that $P^s = P^d = P^m = 50$ Dinars.

Now consider the estimation of the economic price per camp site night in domestic currency generated by the project.

As the inputs used for the production of camp site nights are largely non-tradable (land and labor), the economic price per unit expressed at the domestic price level (P^e) is calculated as:

$$P^e = W^d * P^d + W^s * P^s$$

Since the demand price (P^d) equals the supply price (P^s) and each is equal to 50 Dinars[36], there will be no need to estimate the relative demand and supply weights; and the economic benefit per camp site night will be equal to 50 Dinars. Stated differently, the proportion of the project's sales that will be a mere replacement of the output of the non-project producers has a value of 50 Dinars per camp site night as does the proportion of project's sales that will lead to increased consumption by the demanders of the good.

The commodity-specific conversion factor for camp site nights at the domestic price level ($CSCF^s$) will be equal to one as the economic price per camp night (50 Dinars) is equal to its financial price (50 Dinars).

[36] If the quantity produced by the project is relatively large compared to the total output of the market, it will lead to a drop in the market price of camp site nights. When estimating the economic price per camp site night in such a case, we use the average of the prices without (before) the project and those with (after) the project.

Case 2: A Project Producing a Non-Tradable Output Where

- Distortions Exist In The Market For That Output,
- No Distortions In Factor, Substitute or Complement Markets, and
- Inputs Used for the Production of the Project's Output have Tradable Good Component.

The framework of analysis here is similar to that used earlier to estimate the economic price of a non-tradable output in the absence of distortions in the output market as well as in its factor, substitute and complement markets. The additional supply by the project will drive the market price of the output down, and will lead to a cutback in production by existing producers and an increase in consumption by demanders.

When there is a distortion in the market for the non-tradable output of a project, the distortion drives a wedge between the demand price, P^d, and the supply price, P^s. Figure 4 illustrates the effect of a project on P^d and P^s when the project's output is subject to a sales tax. P^d_0 and P^s_0 are prices without the project; P^d_1 and P^s_1 are prices with the project. The gross economic benefit (economic price) of the output will be the sum of the value of the released resources as measured by the supply curve of the non-project producers - area $Q^s_1ABQ_0$ in Figure 4 - and the value to the demanders of the additional consumption as measured by their willingness to pay - area $Q_0DEQ^d_1$ in Figure 4 (following page). What the demanders pay consists of payments to suppliers (area $Q_0FCQ^d_1$) and taxes to government (area FGEC).

Suppliers would receive $Q_0BCQ^d_1$ only if they could perfectly price discriminate along the demand curve, which is not possible in a competitive market. However, as long as the project's output is small relative to the initial market, $Q_0FCQ^d_1 \approx Q_0BCQ^d_1$ and FGEC ≈ BDEC.

Economic Price of a Non-Tradable Output with Adjustment for the Foreign Exchange Premium

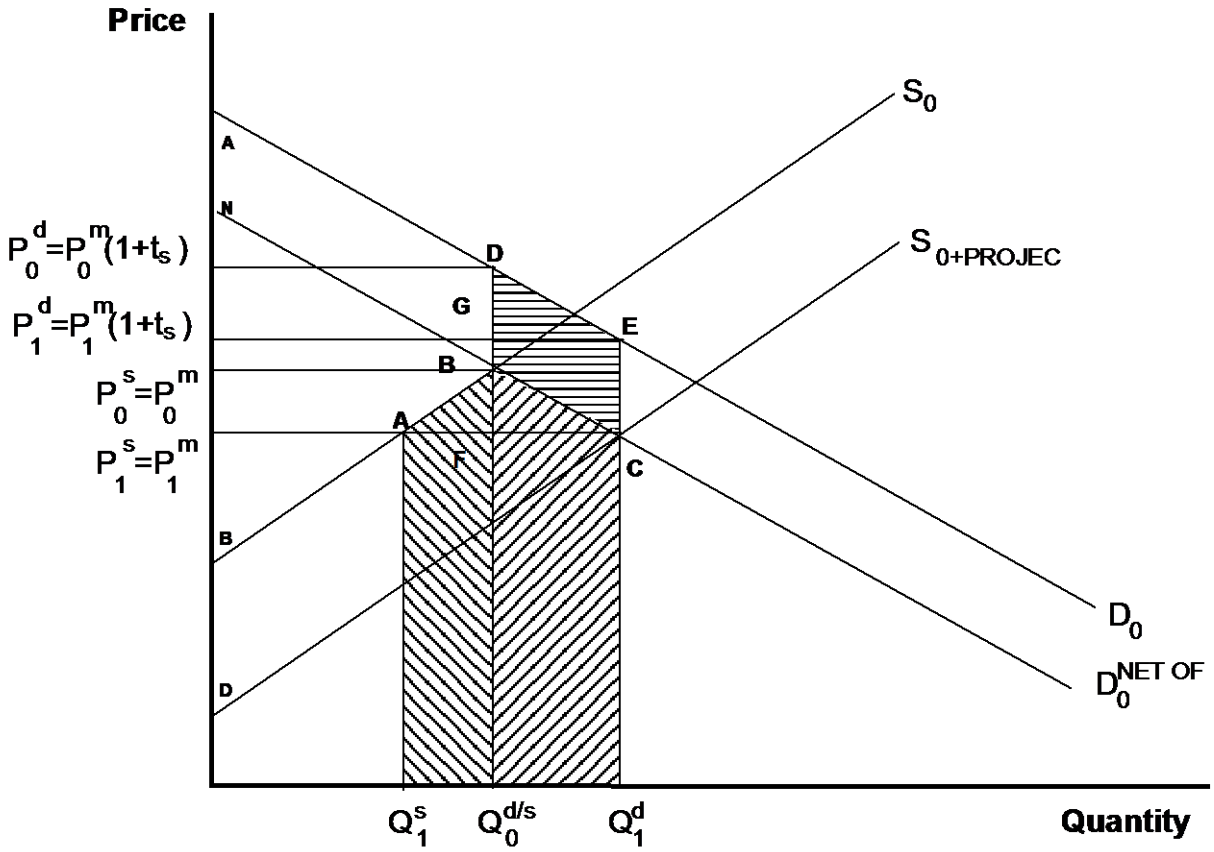
In the previous case, the economic price per unit was estimated as a weighted average of the value of the resources saved as measured by the supply price and value of the additional consumption as measured by the demand price. In that situation, it was assumed there were no distortions in the markets for the factors used to produce the non-tradable output and that they were all non-tradable goods. In addition, it was assumed that there were no distortions in the markets for the output's complements and substitutes.

The supply price used to estimate the value of the saved resources is based on the financial prices of the inputs utilized in the production of the non-tradable output. If all of these inputs are non-tradable goods and there are no distortions in their competitive markets, the supply price will reflect the true economic cost to society of the resources saved.

If there are no distortions in the markets for the inputs used in the production of a non-tradable output but some of these inputs are tradable goods, then the supply price of the output will need to be adjusted to reflect the true economic cost of its tradable components. In this case, the economic benefit per unit of output produced, expressed at the domestic currency, will have two main components. The first one is a weighted average of the value of the released (saved) resources measured by the competitive supply price and the value of the additional consumption measured by the competitive demand price. The second component is the premium on the foreign exchange applicable to the tradable inputs that are now saved as the non-

project suppliers to the market reduce their production of non-tradable output.

Economic Benefits of Project (Tax on Output)



Combining both components, the economic price per unit of non-tradable output expressed in the domestic currency (P^e) is calculated as follows:

$$P^e = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * (\sum_{i=1}^{n} A_{xi} * P^d_i) * (E^e/OER - 1)$$

where $W^d + W^s = 1$

x = output produced by the project
P^d_x= demand price per unit of output
P^s_x= supply price per unit of x
P^d_i= demand price per unit of input i
A_{xi}= input - output coefficient showing the quantity of input i used in the production of one unit of x
E^e= economic exchange rate
OER= official or market exchange rate

The first part, on the right hand side of the equation, is the weighted average of the competitive demand and supply prices. The second part reflects the adjustment for the foreign exchange premium associated with the tradable components of the inputs used in the production of the non-tradable output. This term will be positive, indicating greater benefits to society, if the economic value of foreign exchange is larger than its market value. In this case, the economic value of the resources saved is greater than their financial (supply) value.

To estimate the undistorted tradable input component used in the production of a non-tradable output of a project when there are no distortions in the markets for the factors, one starts by breaking down the inputs used for the production of the output into both tradable and non-tradable components. The non-tradable components can be further broken down into their tradable and non-tradable elements. The financial values of all the tradable components are then added and expressed as a percentage (%T) of the supply price of the non-tradable output in question. Although the process of breaking down the non-tradable components into their tradable and non-tradable parts could be continued for several stages, it is customary to stop after one or two rounds as this will usually yield an acceptable degree of accuracy.

Note that the adjustment for the tradable component pertains only to the proportion of the project's sales (W^s) that replaces some of the resources of existing (non-project) producers. Hence, the adjustment is only applied to the supply side of the market.

In the presence of distortions in the market for a non-tradable output produced by a project, the estimation of the economic price per unit of output will require the determination of the following: (1) the supply price (P^s), (2) the demand price (P^d), (3) the relative weights of demand and supply (W^d and W^s) and (4) the proportion (%T) of the undistorted tradable good component in the output. Taxes levied on the market price (P^m) at the retail level will cause the demand price to be higher than the market price: [$P^d = P^m * (1 + \text{tax rate})$]. Production subsidies given on the total resources spent would cause the supply price to be higher than the market price: [$P^s = P^m / (1 - \text{subsidy rate})$]; while taxes levied at the producers level will cause the supply price to be lower than the market price. Table below gives the relationship between supply, demand and market prices under various types of distortions.

Table

Relationship Between Market Prices And Demand and Supply Prices With Various Types of Distortions[37]

Case	*Type of Tax or Subsidy*	*Supply Price*	*Demand Price*
1	Percentage sales tax (t_s) levied on market price at retail level	$P^s = P^m$	$P^d = P^m(1+ t_s)$
2	Unit sales tax of T_s levied on market price at retail level	$P^s = P^m$	$P^d = P^m + T_s$
3	Percentage subsidy K given on total resources spent on production	$P^s = P^m/(1-K)$	$P^d = P^m$
4	Unit subsidy K_u given per unit output produced	$P^s = P^m + K_u$	$P^d = P^m$
5	Percentage tax (t_p) levied at producers level	$P^s = P^m/(1+t_p)$	$P^d = P^m$
6	Unit tax (T_p) levied at producers level	$P^s = P^m - T_p$	$P^d = P^m$
7	Two percentage taxes t_1 and t_2 levied on output at retail level, (compounded)	$P^s = P^m$	$P^d = [P^m(1+t_1) * (1+ t_2)]$

[37] Harberger, A.C. and Jenkins, G.P., "Manual for Cost Benefit Analysis of Investment Decisions", Unpublished, (2005) chapter 9.

After estimating the economic price of the output, a commodity-specific conversion factor (CSCF) can be obtained by dividing the economic value per unit of output by its financial value:

$CSCF^s$ = Economic price per unit / Financial (supply) price per unit

Illustrative Example 2: A Project Providing Hotel-Room Nights

Consider the competitive market for hotel rooms in a beach resort where the quantities demanded and supplied are measured in terms of hotel-room nights per year. At present, there is a 25% sales tax (t_s) levied on the market price of room nights and the competitive quantity demanded and supplied is 60,000 room nights at a market price (P^m) of 800 Dinars per night. Now introduce a project that will provide 4,000 room nights per year. Assume that the impact of the project output on the competitive market price is small and that the proportion of the undistorted tradable good component (%T) that is used in the production of hotel room nights is estimated to be 60% of the supply price (P^s).

Let P^s = the supply price per room night,
P^d = the demand price per room night; and
P^m = the market price per room night.

Consider the estimation of the economic benefit per room night generated by the project.

Estimation of the Economic Price of Hotel-Room Nights in Domestic Currency:
(The figures in this example are assumed for illustrative purposes only)

The estimation of the economic price of hotel-room nights involves the following three initial steps:

Step 1: Estimate the demand price

$P^d = P^m * (1 + t_s)$
$= 800 * (1.25)$
$= 1000$ Dinars

Step 2: Estimate the supply price

$P^s = P^m$
$= 800$ Dinars

Step 3: Estimate the supply and demand weights (W^s and W^d)

For a hotel in a beach resort, one would expect consumers to be considerably more responsive than suppliers to changes in room rates. As this type of recreation is by no means a necessity, one would have reason to believe that consumers are highly sensitive to price changes. In addition, the existence of other beach resorts as well as other competing types of recreation, will provide consumers with a relatively large menu of choices. Suppliers of such facilities, on the other hand, do not have the same range of options to reemploy their resources. Hence, it would seem reasonable to assign a higher weight to the demand side response of the market than to its supply side response. It may therefore be appropriate to use $W^d = 0.67$ and $W^s = 0.33$.

Now substituting in to equation, the economic price per unit expressed in domestic currency

$(P^e) = W^d * P^d + W^s * P^s + W^s * \%T * P^s * (E^e/OER - 1)$
$= 0.67 * 1000 + 0.33 * 800 + 0.33 * 0.60 * 800 * (50/45 - 1)$
$= 951.6$ Dinars.

Note that the value of the foreign exchange adjustment of the undistorted tradable component of the non-tradable output (the

third part on the right hand side of the equation) is 17.6 Dinars per unit, a value less than 2% of the economic price per hotel night produced by the project. If a crude estimation of the undistorted tradable good component (%T) of hotel room nights had yielded a result of 40% instead of the actual 60%, the economic price per hotel-room night would have come out to 945.7 Dinars instead of 951.6 Dinars, a difference of less than 1% of the economic price per night. The value of the foreign exchange adjustment in the above equation will be smaller, the smaller the supply weight (W^s), the undistorted tradable good component (%T) of the non-tradable output and the difference between the official exchange rate and the economic exchange rate.

The commodity-specific conversion factor ($CSCF^s$) for hotel room nights in this resort is given by:

$$CSCF^s = P^e / P^s$$
$$= 951.6 / 800$$
$$= 1.189$$

Case 3: A Project Using a Non-Tradable Intermediate Good Where

- Distortions exist in the market for that intermediate good,
- No distortions exist in its factor, substitute or complement markets.
- Inputs used for the production of that intermediate good have tradable component.

When a project purchases a non-tradable input in a market where prices are competitively set, the price of the input will in general be bid up due to the additional demand. As the price of the non-tradable input increases, consumers will reduce their purchases of the input, and at the same time, the higher prices will provide an incentive for suppliers of the input to expand production.

Estimation of the Economic Price of an Intermediate Good used as an Input of a Project

In the absence of distortions in the factor markets of an intermediate good and in the markets for its complements and substitutes, and if all inputs used in the production of the non-tradable good are also non-tradable, then the economic cost of the input used by the project is a weighted average of the value of the additional supply (as measured by the supply curve) and the value of the consumption given up by demanders (as measured by the demand curve). However, if some of the inputs used in the production of the non-tradable intermediate good are tradable goods, then the supply price will need to be adjusted to reflect the economic cost of the tradable components[38].

The economic price per unit of intermediate good purchased expressed in domestic currency (P^e), can be broken down into two main parts: the first, is a weighted average of the value of the resources used in the production of the additional supply as measured by the competitive supply price and the value of the consumption given up by the demanders as measured by the competitive demand price. The second part is the premium on the foreign exchange spent on the tradable inputs used in the increased production of the non-tradable intermediate good.

[38] The nature and mechanics of the adjustment are explained in detail in an earlier section where we estimate the economic price of a non-tradable output produced by a project when some of the inputs used in the production of the output are tradable goods.

Combining both parts, the economic price per unit of non-tradable input used by the project and expressed at the domestic price level (P^e) is calculated as follows:

$$P^e = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1)$$

where $W^s_x + W^d_x = 1$

x = intermediate good purchased by the project

%T = undistorted tradable good component of the non-tradable intermediate good used by the project expressed as a % of the financial supply price of the intermediate good

E^e = economic exchange rate

OER = official or market exchange rate

The first two terms on the right hand side of the equation yield the weighted average of the demand and supply prices. The last term reflects the adjustment for the foreign exchange premium attached to the undistorted tradable components of the inputs used in the production of the non-tradable intermediate good. This part will be positive, indicating a greater cost to society, if the economic value of the foreign exchange is larger than its market value, i.e., the economic value of the tradable inputs is greater than their financial value. Note that the adjustment for the tradable component pertains only to the proportion of the project's demand for the intermediate good (W^s) that is met through additional production. The proportion of the project's demand that is accommodated through a reduction in the purchases of other consumers (W^d) should not be adjusted to reflect the distortions in the input markets. Since the production of this proportion will be carried out regardless of whether the project is undertaken, the adjustment is applied to only the additional supply to this market.

In the presence of distortions in the market for an intermediate good, the estimation of the economic price (P^e) of the good will also require the determination of the following: (1) the intermediate input's supply price (P^s), (2) its demand price (P^d), (3) the relative weights of demand and supply (W^d and W^s) and (4) the proportion (%T) of the undistorted tradable good component in the costs of production of the intermediate input.

After the estimation of the economic price of the intermediate input, a commodity-specific conversion factor ($CSCF^d$) based on the financial demand price of the input can be calculated as follows:

$CSCF^d$ = Economic price per unit / Financial (demand) price per unit

Illustrative Example 3: A project using bricks as an input

Consider the competitive market for clay bricks where at present, there is a 25% sales tax (t_s) on the market price of bricks and a 15% subsidy (K) on the suppliers' cost of production. The quantity demanded and supplied in the market is 7 million bricks per month at a market price (P^m) of 7 Dinars per brick. Now, we introduce a project to construct low-cost housing. During the later stages of the construction, it is expected that the project will require 300,000 bricks per month. Assume that the impact of the project demand on the competitive market price is small and that the proportion of the undistorted tradable good component (%T) used in the production of bricks is estimated to be 70% of the supply price (P^s).

Let P^s = the supply price per brick,

P^d = the demand price per brick; and

P^m = the market price per brick.

Consider the estimation of the economic cost of bricks in domestic currency used by this project.

Illustration: Estimation of the Economic Price of Bricks.

(The figures in this example are assumed for illustrative purposes only)

Step 1: Estimate the demand price

$P^d_x = P^m_x * (1 + t_s)$

= 7 * (1.25)

= 8.75 Dinars

Step 2: Estimate the supply price

$P^s_x = P^m_x / (1 - K)$

= 7 / (0.85)

= 8.24 Dinars

Step 3: Estimate the supply and demand weights

For such production activity, the expected supply response will be small in the short run as most brick making kilns are usually operating close to capacity.[39] Although the supply response will be larger in the longer run, it will still not be as large as the demand response. In other words, a larger proportion of the bricks required by the project will be obtained by existing demanders' postponing their consumption, rather than from new production. Hence, assigning a weight of 0.67 to the demand side and a weight of 0.33 to the supply side seems plausible.

Now substituting, the economic cost per brick at the domestic price level (P^e)

$= W^d * P^d + W^s * P^s + W^s * \%T * P^s * (E^e/OER - 1)$

$= 0.67 * 8.75 + 0.33 * 8.24 + 0.33 * 0.7 * 8.24 * (50 /40 - 1)$

= 8.79 Dinars.

If the value of the foreign exchange adjustment for the tradable component of the intermediate good used by the project were to be ignored, the economic cost per brick would be 8.58 Dinars per unit. In other words, the economic cost would be underestimated by approximately 2% of the true economic cost per brick.[40]

The commodity-specific conversion factor ($CSCF^d$) for bricks used by this project is given by:[41]

$CSCF^d = P^e / P^d$

= 8.79 / 8.75

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[39] In the case of existing excess capacity, more weight should be assigned to the supply side. As the situation of excess capacity will likely be temporary, however, no generalizations can be made about the economic cost or the conversion factor of this non-tradable input.

39 The value of the foreign exchange adjustment to the undistorted tradable component of the intermediate good used by the project is calculated as follows:

$= W^s * \%T * P^s * (E^e/OER - 1)$

$= 0.33 * 0.7 * 8.24 * (50/45 - 1)$

= 0.21 Dinars per brick.

40 Since the project uses bricks as an input, the relevant financial price in the estimation of the commodity-specific conversion factor is the demand price inclusive of the 25% sales tax.

= 1.0045

Case 4: A Project using a non-tradable intermediate good as an input where

- Distortions exist in the market for that intermediate good
- Distortions exist in its factor markets,
- No distortions in its substitute or complement markets
- Inputs used in the production of the intermediate good have tradable good component.

In the previous section, a framework was established for estimating the economic cost of a non-tradable intermediate good where only the market for that good was distorted. In other words, it was assumed that the financial prices of the inputs used in the production of the intermediate good reflected their economic values. This section outlines a framework for estimating the economic cost of an intermediate good when there are distortions in both the market for the intermediate good and in its factor markets.

Estimation of the economic price of an intermediate good with distortions in both the market for the intermediate good and its factors markets

When distortions exist in the market for an intermediate good, but in none of the markets for its factors, substitutes or complements, the economic cost per unit of that intermediate good (P^e) is calculated as a weighted average of the supply price (P^s) and the demand price (P^d), plus an adjustment for the foreign exchange premium on the tradable components used in the production of intermediate good.

$$P^e = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1)$$

However, if distortions also exist in the factor markets, an adjustment to the above equation is required when estimating the economic cost of the intermediate good. If, in the production of intermediate good x, only input i is distorted, then the economic cost per unit of the intermediate good used by the project (P^e) is estimated as follows:

$$P^e = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1) - W^s_x * A_{xi} * (P^d_i - P^e_i)$$

where
- x = intermediate good demanded by the project
- A_{xi} = input -output coefficient showing the quantity of input i used in the production of one unit of x
- $\%T$ = undistorted tradable good component of the intermediate input x expressed as a percentage of the financial supply price of x
- P^d_x = demand price per unit of x
- P^s_x = supply price per unit of x
- P^d_i = demand price per unit of input i
- P^e_i = economic value per unit of input i expressed in domestic currency.

In the case where a value-added tax (VAT) is levied on both an intermediate good and its

inputs, the VAT on the inputs is not recognized as a tax because such input taxes are allowed as a credit against the VAT on the intermediate good. If the intermediate good is exempt from VAT, the tax on the inputs is treated like a sales tax because no credit is possible at the intermediate good level. If less than full credit is given for the input taxes, then the excess is treated as an input tax. Where the credit given at the intermediate good level is greater than the underlying taxes paid on the inputs, the excess credit is treated as a subsidy on the purchase of the intermediate input.

Note that any adjustments for the intermediate good x are weighted by W^s_x, the share of the project's demand for the intermediate good x that is met by increased supply. This adjustment for input distortions only applies to the additional inputs utilized because of the increased production. The proportion of the project's demand that is met through a cutback in the demand of other consumers, W^d_x, is valued at the demand price P^d_x and should not be adjusted to reflect the distortions in the input markets. This is due to the fact that these inputs will be used in the production of this intermediate good x whether or not the project being considered is implemented.

When several inputs used in the production of the intermediate good x have distortions in their markets, a more general form can be used:

$$P^e = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1)$$

$$- W^s_x * \sum_{i=1}^{n} A_{xi} * (P^d_i - P^e_i)$$

In the absence of distortions in the factor markets, the data required to estimate the economic cost of an intermediate good x are the supply and demand prices for the good, its relative demand and supply weights and its undistorted tradable good component (%T). With distortions in the factor markets, three additional pieces of information are required for each distorted input i: (1) its input-output coefficient (A_{xi}), (2) its demand price (P^d_i) and (3) its economic price (P^e_i).

If the commodity-specific conversion factors ($CSCF^d_i$) are known for all inputs that have distortions in their markets and that are considered in the estimation of the economic cost of the intermediate good (P^e_x) the following alternative representation of equation can be used:[42]

$$P^e_x = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1)$$

$$- W^s_x * \sum_{i=1}^{n} \{A_{xi} * (1 - CSCF^d_i) * P^d_i\}$$

The process of adjusting the economic cost of intermediate goods for differences between the financial (demand) prices and the economic prices of their inputs could be iterated back through several stages of production. However, correcting for the distortions in the market for an intermediate

[42] Since the supply price of an intermediate good x is based on the financial demand prices of all inputs used in its production, one should use the demand price to estimate the commodity-specific conversion factor ($CSCF^d$) for each of the inputs. Note that the commodity-specific conversion factor calculated on the basis of the demand price could be represented in terms of the commodity-specific conversion factor calculated on the basis of the supply price ($CSCF^s$) as follows:

$$CSCF^d = CSCF^s * (P^s / P^d).$$

See Asian Development Bank, Economics Office, "Guidelines For Economic Analysis of Projects" (1987) page 93.

good and its factor markets, will generally yield an acceptable degree of accuracy.

After the estimation of the economic price of an intermediate good x, its commodity-specific conversion factor ($CSCF^d_x$) can be calculated as follows:

$CSCF^d_x$ = Economic Price per unit / Financial (demand) Price per unit

Specifically,

$$CSCF^d_x = [W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1) - W^s_x * \sum_{i=1}^{n} \{A_{xi} * (1 - CSCF^d_i) * P^d_i\}] / P^d_x$$

If there are taxes on the sale of the intermediate good and subsidies on its resource cost, we can incorporate these, as well. Since

$P^s_x = P^m / (1 - k)$ and $P^d_x = P^m * (1 + tax)$

Then $P^s_x = P^d_x / [(1+tax)*(1-k)]$

Therefore,

$$CSCF^d_x = [W^d_x * P^d_x + W^s_x * P^d_x /((1+tax)*(1-k)) + W^s_x * \%T * P^d_x /((1+tax) * (1-k)) * (E^e/OER-1) - W^s_x * \sum_{i=1}^{n} A_{xi} * (1 - CSCF^d_i) * P^d_i] / P^d_x$$

Note that if the cost proportions of inputs C_i are known, but the input-output coefficients are not, we can substitute for A_{xi}:

$A_{xi} = C_i * (P^s/P^d_i)$.

Simplifying at the same time, we have:

$$CSCF^d_x = W^d_x + W^s_x * (1/(1+tax)*(1-k)) * [\{1 + \%T * (E^e/OER-1)\} - \sum_{i=1}^{n} C_i * (1 - CSCF^d_i)]$$

Illustrative Example 4: A project using bricks as an input when there are distortions in the markets of clay and furnace oil (two of the inputs used in brick production)

(The figures in this example are assumed for illustrative purposes only)

Consider the competitive market for clay bricks where a 25% sales tax (t_s) is levied on the market price of bricks and a 15% subsidy (K) is set on the supplier's cost of production. Without the project, the quantity demanded and supplied in the market is 7 million bricks per month at a market price (P^m_x) of 7 Dinars per brick. Now introduce a project that requires 300,000 bricks per month and assume that the impact of the project demand on the competitive market price for bricks is small.

Two of the inputs used in the production of bricks have distortions in their markets: (1) Clay, a non-tradable good with no tradable components, has a 20% sales tax (t_s) levied on its market price (P^m_c) of 250 Dinars per ton;[43] (2) Furnace oil, an importable good, has a subsidy (K_{oil}) of 50% on its CIF price of US

[43] It is being assumed that the change in the market price of clay on account of the project's demand is relatively small, hence justifying the use of without-the-project prices, rather than an average of the prices with and without the project.

$240 per ton. The input-output coefficient for furnace oil (A_{xoil}) is 180 kilograms of oil per 1000 bricks and that of clay (A_{xc}) is 3.5 tons of clay per 1000 bricks. The undistorted tradable good component (%T) of bricks is estimated to be 55% of the supply price of bricks.

Let x : the intermediate good demanded by the project (bricks)

P^s_x : the supply price per brick,

P^d_x : the demand price per brick,

P^m_x : the market price per brick,

A_{xi} : the input output coefficient indicating the use of input i in the production of x,

P^s_i : the supply price per unit of input i,

P^d_i : the demand price per unit of input i,

P^e_i : the economic value per unit of input i expressed in domestic prices,

c : clay.

Now consider the estimation of the economic cost per brick used by this project.

Estimation of the Economic Price of Bricks in Domestic Currency (adjusting for distortions in markets of clay and oil):

The economic cost per brick (P^e_x) is estimated using equation:

$$P^e_x = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1) - W^s_x * \{A_{xc} * (P^d_c - P^e_c) + A_{xoil} * (P^d_{oil} - P^e_{oil})\}$$

The first four terms on the right hand side of the equation have been previously determined and have the following values:

$W^s_x = 0.33$, $P^s_x = 8.24$ Dinars, $W^d_x = 0.67$ $P^d_x = 8.75$ Dinars

As the values of the foreign exchange premium, the input-output coefficients for clay and oil, and the undistorted tradable good content are known, it only remains to estimate the economic prices and the financial demand prices for the two inputs. The estimation of the economic price of clay will be carried out according to the procedure detailed for non-traded goods and will first require the determination of both the supply price and the relative supply and demand weights for clay.

1. Clay

Step 1: Estimating the demand price

$P^d_c = P^m_c * (1 + t_s)$
$= 250 * (1.2)$
$= 300$ Dinars per ton

Step 2: Estimating the supply price

$P^s_c = P^m_c$
$= 250$ Dinars per ton

Step 3: Estimating the supply and demand weights

If clay is not in short supply, one can reasonably assert that the demand for clay derived from the project's demand for bricks will be mostly met from additional supply. Accordingly, a demand weight (W^d_c) of 0.33 and a supply weight (W^s_c) of 0.67 are assigned.

The economic cost of clay[44] (P^e_c) = $W^d_c * P^d_c + W^s_c * P^s_c$

= 0.33 * 300 + 0.67 * 250

= 266.5 Dinars per ton.

$CSCF^d_c$ = Economic price / Financial (demand) price

= 266.5 / 300

= 0.888

2. Furnace Oil

Step 1: Estimating the demand price

P^d_{oil} = CIF price * OER * (1 - K_{oil})

= 240 *45 * (1 - 0.5)

= 5,400 Dinars per ton

Step 2: The economic cost of furnace oil (P^e_{oil})

= CIF price * E^e

= 240 * 50

= 12,000 Dinars per ton

$CSCF^d_{oil}$ = Economic price / Financial (demand) price

= 12,000 / 5,400

= 2.22

Now that the estimation of the economic costs of the two inputs is completed, the economic cost per brick (P^e_x) at the domestic price level can be calculated as follows:

$P^e_x = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1)$

$- W^s_x * \{A_{xc} * (P^d_c - P^e_c) + A_{xoil} * (P^d_{oil} - P^e_{oil})\}$

= 0.67*8.75 + 0.33*8.24 + 0.33*0.55*8.24*(50/45 - 1)

- 0.33*{0.0035*(300 – 266.5) + ($18*10^{-5}$)*(5400 – 12000)}

= 9.17 Dinars per brick

In the absence of distortions from the markets of the inputs used in the production of bricks, the economic cost per brick was calculated earlier to be 8.79 Dinars. The divergence between this value and the one just estimated (with distortions in the factor markets) is primarily due to the highly subsidized furnace oil. While the net loss to the government due to the subsidy on fuel is 392 Dinars per 1000 bricks used,[45] the effects of the distortions in the clay market on the economic price of bricks are far more negligible.

If the commodity-specific conversion factors ($CSCF^d_i$) for clay and furnace oil are known, then the economic cost per brick at the domestic price level (P^e_x) can be calculated as follows:

$P^e_x = W^d_x * P^d_x + W^s_x * P^s_x + W^s_x * \%T * P^s_x * (E^e/OER - 1)$

$- W^s_x * \{A_{xc} * (1 - CSCF^d_c) * P^d_c + A_{xoil} * (1 - CSCF^d_{oil}) * P^d_{oil}\}$

= 0.33*8.24 + 0.67*8.75 + 0.33*0.55*8.24*(50/45 - 1)

[44] Clay has no tradable content and hence, does not require any foreign exchange adjustment.

[45] This is calculated as follows: $- W^s_x * A_{xoil} * (P^d_{oil} - P^e_{oil})$

= $-0.33*(18*10^{-5})*(5400 – 12000)$

= 0.392 Dinars per brick

- 0.33*{0.0035*(1 - 0.888)*300 + (18*10^{-5})*(1 - 2.3)*5400}
= 9.17 Dinars per brick.

The commodity-specific conversion factor ($CSCF^d_x$) for bricks purchased by the project is calculated as follows:

$CSCF^d_x$ = P^e_x / P^d_x
= 9.17 / 8.75
= 1.048

Appendix 4: Estimation of Economic Prices For Goods & Services in regulated markets

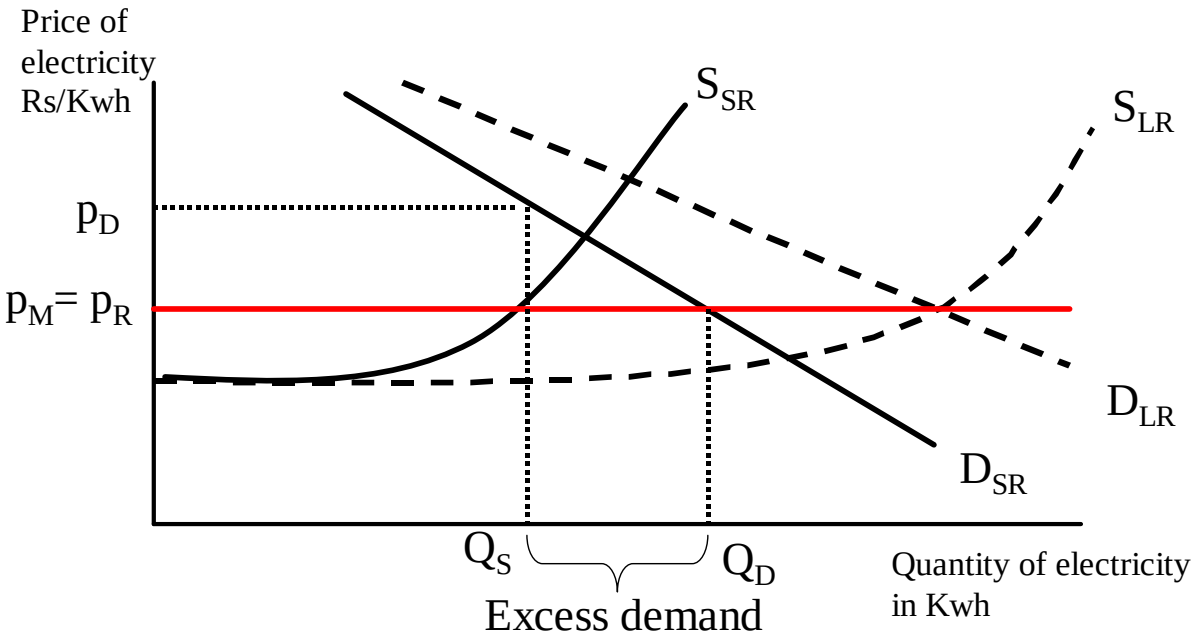
Introduction

The third category of goods for which a methodology for estimating economic prices is required is goods and services traded in regulated markets. These are typically non-traded public services or utilities where the price is set by the government or by some regulatory authority. Typical examples are the supply of water or electricity services. In these markets, it is generally the case that the market price is not allowed to respond flexibly with changes in market demand or supply. As a result, imbalances can exist that require additional allocation mechanisms to balance the markets. For example, some rationing mechanism may be used to allocate goods in a market with a shortage of supply. How a market is brought to equilibrium affects how added supply from a project is absorbed by the market, or how added project demand is sourced from the market, and hence, how its economic value is determined.

The case of electricity is used to illustrate the method of valuation in a regulated market.

Figure Y.1 illustrates a regional electricity market where the market price (p_M) is regulated at p_R. At this price the short-run market demand (D_{SR}) exceeds the short-run supply of electricity (S_{SR}) such that there is an excess demand ($Q_D - Q_S$). Over time with expanded investment in electricity supply as well as possible adjustments in the investments in electricity using equipment the market could come to equilibrium between the long supply (SLR) and long run demand (DLR) at the regulated price p_R. Disequilibria may persist, however, for an extended period if investment in added production capacity lags behind the growth in demand at the regulated price. This is not uncommon because of the capital-intensity of the electricity sector causing long planning and investment periods combined with delays and uncertainty caused by regulatory processes.

Figure Y.1 Excess demand for electricity in a regional electricity market



In the short-run some mechanism is needed to bring the market to equilibrium. Two classes of mechanism are recognized – price and quantity rationing mechanisms. Pure quantity rationing mechanisms are difficult to enforce as the beneficiaries of a ration can typically resell their ration in a parallel market at a higher price if excess demand exists. For example, in Figure Y.1, the quality supplied (Q_S) at p_R actually commands a price by electricity users of p_D which exceeds p_R. Hence, a user buying electricity at p_R theoretically could resell the electricity at p_D and earn a surplus of ($p_D - p_R$) per Kwh resold. In most markets where goods are storable, nonperishable and salable at low transaction costs, rationed items that are in short supply would be resold at higher prices in parallel markets. Effectively, this is equivalent to price rationing bringing the market back to equilibrium. Electricity, however, is difficult to store and resell, and hence, quantity rationing is feasible and often used. Price rationing, however, could be used to remove the excess demand for electricity.

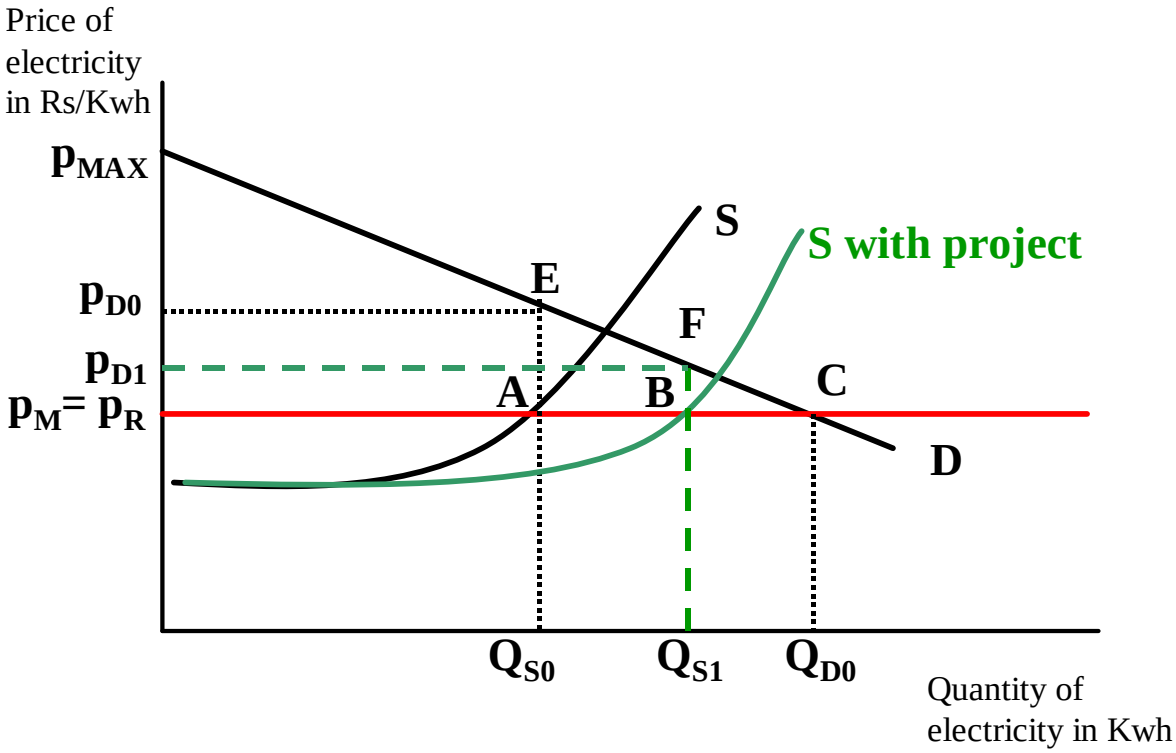
A number of price rationing mechanisms are possible. Price rationing can be achieved by adding a tax or surcharge to raise the price to users up to p_D. Alternatively, quota could be used to restrict demand, but the quota could either be auctioned or sold at a quota price of ($p_D - p_R$) per Kwh, or the quota could be tradable such that the resale price of the quota would be ($p_D - p_R$) per Kwh. Users of electricity would then pay the regulated price (p_R) plus the tax, surcharge or quota price of ($p_D - p_R$), resulting in the market-clearing price of p_D being paid by users.

Economic value of a price-regulated good with price rationing

If an electricity generation project is implemented in a market with a regulated price and price rationing, then the economic value of the added electricity supplied can be estimated using the techniques already presented for non-traded goods. The only difference is that the market price to other electricity producers does not decline because of the price regulation so that other producers do not reduce their supply in response to the added supply. This means that all the added supply gets absorbed by incremental demand and the ration or quota price, tax or surcharge becomes lowered for this added demand to happen.

Figure Y.2 illustrates the market adjustment to absorb the added electricity supply in the case of price rationing being used to control the excess demand. Without the new electricity supply project, the market demand is constrained to the supply of Q_{S0} Kwh by the surcharge of ($p_{D0} - p_R$) per Kwh. The new project expands the supply by ($Q_{S1} - Q_{S0}$) such that the electricity surcharge drops to ($p_{D1} - p_R$) or the full price paid by users drops from p_{D0} to p_{D1} . The gross economic benefit of this expanded supply is given by the area under the demand curve or area $Q_{S0}EFQ_{S1}$. The economic price of the electricity supplied by the project (p^e) is this value divided by the project supply ($Q_{S1} - Q_{S0}$) or the average demand price for this incremental supply or $p^e = (p_{D0} + p_{D1})/2$

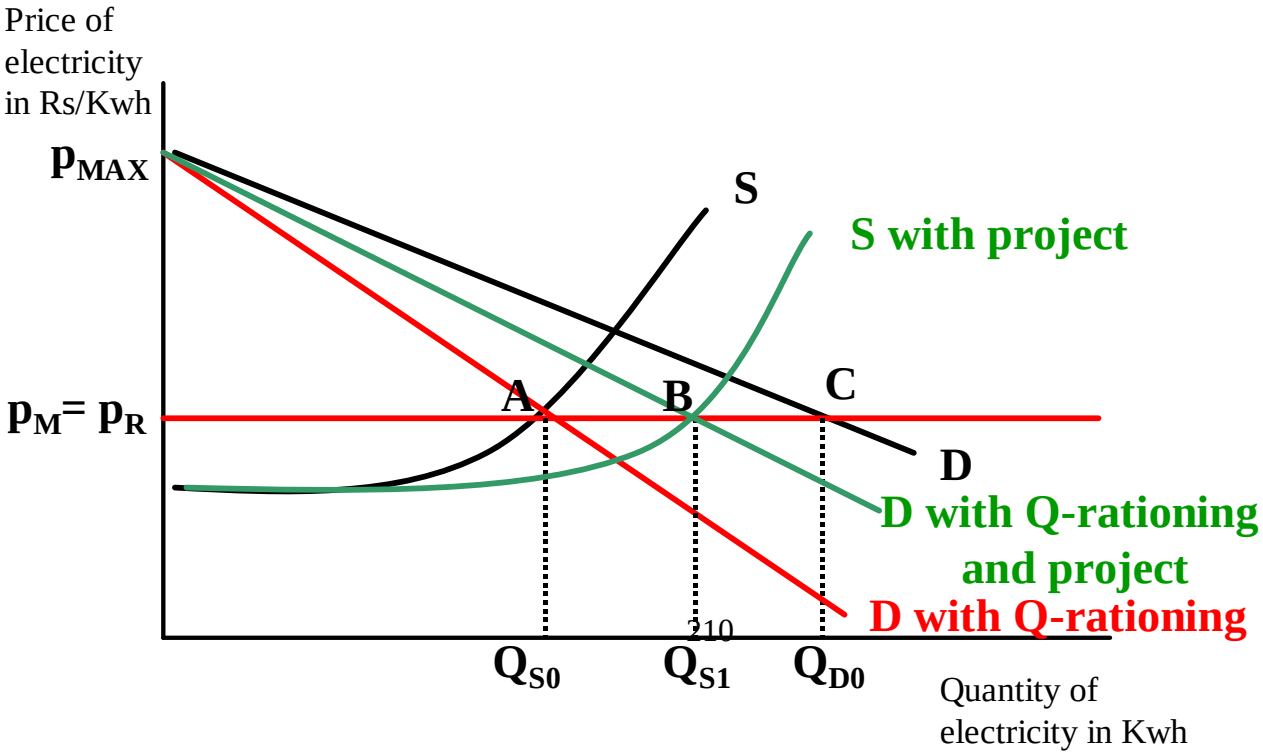
Figure Y.2: Valuation of added electricity supply in a market with excess demand that is removed by price rationing.



Economic value of a price-regulated good with quantity rationing

As noted above, quantity rationing is relatively common in regulated electricity markets since quantity rationing can be made effective because of the difficulties of the user in reselling electricity.

Figure Y.3: Valuation of added electricity supply in a market with excess demand that is removed by quantity rationing (Q –rationing)



Appendix 5: Evaluation of Stakeholder Impacts in Cost Benefit Analysis

Introduction

The social analysis of a project may be organized into two parts; estimating how the income changes caused by the project are distributed (including the reconciliation of financial, economic, and distributional appraisals), and identifying the impact of the project on the principal objectives (basic needs) of the society. The distributional analysis or the stakeholder analysis is the subject of this Chapter.

The distributive analysis of the project asks the following questions: Who will benefit from the project and by how much? Who will pay for the project and how much will they pay? Project sustainability is heavily impacted by which party in the project's sphere of influence gains or loses. If an influential group is expected to bear the burden of losses, then the successful implementation of the project may be hindered. The risk of a strong political opposition to the project mobilized by the losing party is a contingency that the project implementers should be prepared to tackle.

Distributive Analysis

A traditional financial analysis examines the financial feasibility of the project from the owners' and total investment point of view. Economic analysis evaluates the feasibility from the point of view of the whole country or economy. A positive economic net present value (NPV) implies a positive change in the wealth of the country, while a positive net present value from the point of view of those with a financial interest in it, indicates a positive expected change in the wealth of these particular stakeholders.

The difference between the financial and economic values of an input or output represents a benefit or a cost that accrues to some party other than the financial sponsors of the project. These differences can be analyzed by undertaking a distributive analysis that allocates these externalities (differences between economic and financial) to the various parties affected. For example, a project that causes the price of a good to fall will create economic benefits that are greater than its financial revenues. This difference between the financial and the economic values will represent a gain to the consumers of the output and a somewhat smaller loss to the other producers of the good or service who are competing in the market with the project. The differences between the financial and economic values of inputs and outputs also may arise due to a variety of market distortions such as taxes and subsidies, or because the item is sold to consumers at a price different from the marginal economic cost of additional supply.

Tariffs, export taxes and subsidies, excise and sales taxes, production subsidies and quantitative restrictions create common market externalities. Public goods are normally provided at prices different than their marginal economic costs. The economic values of common public services such as clean water and electricity are the maximum amounts people are willing to pay for these services. These values are often significantly greater than the financial prices people are required to pay for the services. Any of these factors will create divergences between the financial and the economic prices of goods and services consumed or produced by a project.

A distributive analysis is composed of six distinct steps:

- Identify the externalities;
- Measure the net impact of the externalities in each market as the real economic values of resource flows less the real financial values of resource flows;
- Measure the values of the various externalities throughout the life of the project and calculate their present values (using the economic discount rate);
- Allocate the externalities across the various stakeholders of the project;
- Summarize the distribution of the project's externalities and net benefits according to the key stakeholders in society;
- Reconcile the economic and financial resource flow statements with the distributional impacts.

In essence, a distributive analysis seeks to allocate the net benefits/losses generated by a project. As a result, this analysis is important to decision makers, as it lets them estimate the impact of particular policies or projects on segments of society, and to predict which groups will be net beneficiaries and which groups will be net losers.

Reconciliation of Economic and Financial Values of Inputs and Outputs

When the economic values and corresponding financial values of variables are expressed in terms of the same numeraire, then we wish to show for each variable that the economic value can be expressed as the sum of its financial value plus the sum of the externalities which cause the financial and economic value to differ. These externalities may be reflecting such things as taxes, subsidies, changes in consumer and producer surplus or public good externalities.

If each of the variables are discounted using any common discount ratio (in this case the economic discount rate), it must also be the case that the net present value of the economic net benefits are equal to the net present value of the financial net benefits, plus the present value of the externalities.

This relationship can be expressed as in equation (1) below:

$$NPV^e_e = NPV^f_e + \sum PV_e\ (EXT_i), \qquad (1)$$

where NPV^e_e is the net present value of economic benefits and costs, NPV_e^f is the net present value of the financial benefits and costs, and $\sum PV_e\ (EXT_i)$ is the sum of the present value of all the externalities generated by the project; all discounted using a common rate of discount.

To indicate how this relationship holds for non-traded and traded goods, the following situations are considered.

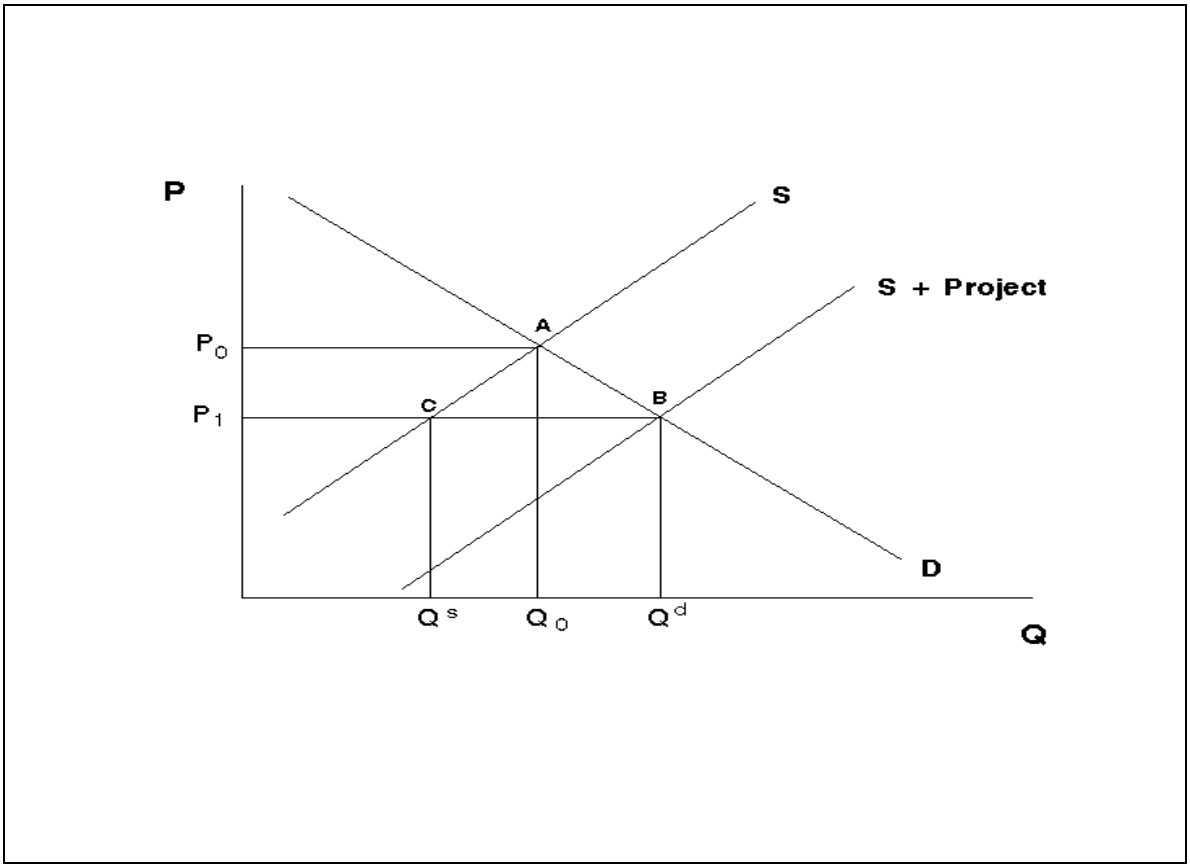
The Case of a Major Expansion in the Supply of a Non-Traded Good in an Undistorted Market

In Figure below we illustrate the market of a good that is the output of a project and the market is undistorted. The project results in a non-marginal increase in the supply of a non-traded good in a market with no tax or subsidy distortions. One such example would be a project that increases the supply of drinking water, at a lower cost, hence expanding total consumption while also reducing the quantity generated by higher cost plants.

Before the project was introduced, the equilibrium price and quantity were P_0 and Q_0, respectively. P_0 represents the price paid for drinking water prior to the project. Introducing the project causes the supply curve to shift to the right. Price falls to P_1 , which is the price of drinking water after the project; total demand increases to Q^d, and the quantity supplied by others is reduced to Q^s. The financial value of the output is Q^sCBQ^d and the economic value is Q^sCABQ^d. The difference (economic - financial) is CAB, which is the sum of two distributional impacts. CAB is the difference between the gain in consumer surplus, P_1P_0AB, and the loss in producer surplus, P_1P_0AC.

Figure

FINANCIAL AND ECONOMIC VALUES FOR PRODUCTION OF NON -TRADED GOOD IN UNDISTORTED MARKET



In summary, when there are no distortions in a market, the gross value of a non-traded good or service from a project which causes a significant change of the price of the good or service can be decomposed into:

Economic Value of the output = Financial Value of the output + Gain in Consumer Surplus - Loss in Producer Surplus

While the example assumes that there is a market determined price before and after the project, this could just as easily be an illustration of public services such as a road, before and after it has undergone a major improvement. In such a case, P_0 would reflect the time and operation costs (per vehicle-mile) before the project, and P_1 would be the sum of these costs per vehicle-mile after the project.

The Case of Non-Traded Good Sold into a Market with a Unit Tax[46]

We will now introduce a distortion into the market. Now we have added a unit tax on the non-traded good, which results in the demand curve facing the producer to shift downward to Dn. Before we introduce our project to the market, we have an equilibrium quantity of Q_0, a supply price of P^s_0, and a demand price of P^d_0, which is equal to the supply price plus the unit tax. After we introduce the project, the quantity demanded increases to Q^d, quantity supplied by producers other than the project falls to Q^s, the supply and demand prices fall to P^s_1 and P^d_1, respectively. The financial value of the output is shown as Q^sCBQ^d. The economic value is shown as Q^sCAQ_0 which is the value of resources saved through the contraction or postponement of supply by others, in addition to Q_0ABQ^d plus AEFB, the value to consumers of the increase in the quantity demanded.

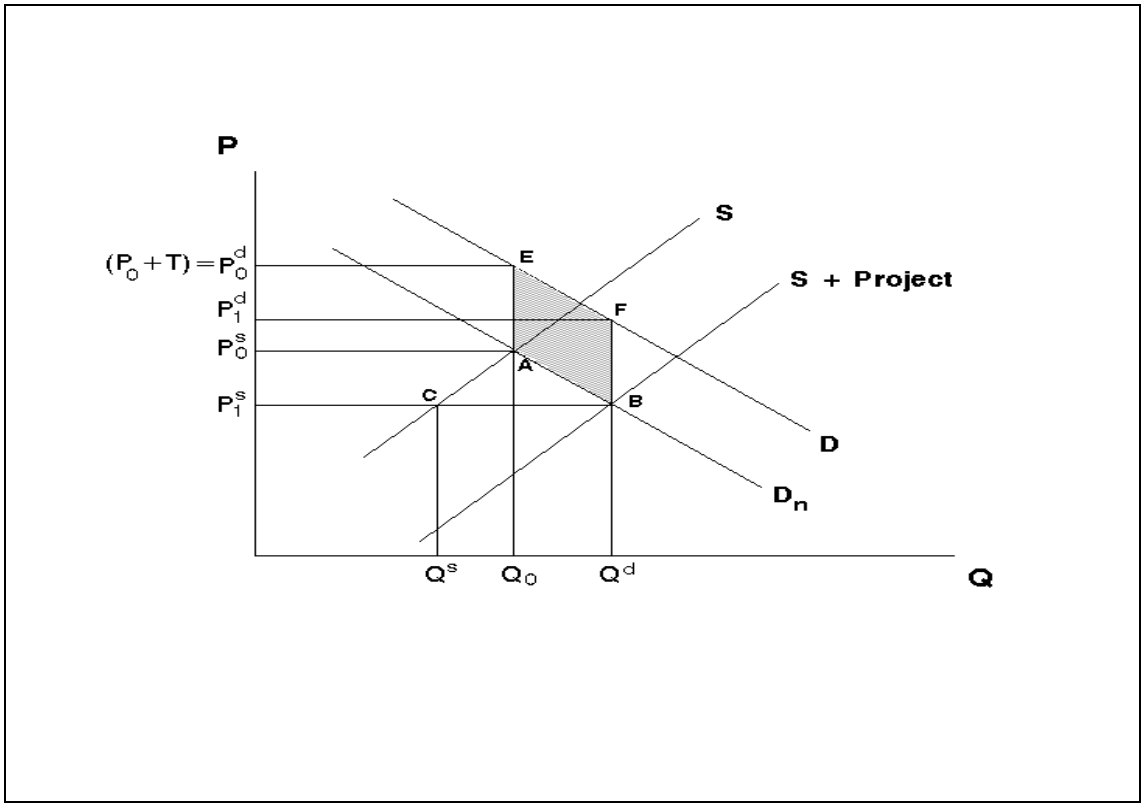
The difference between the economic and financial appraisal of the project's output in this case is equal to CAB plus AEFB. Here again, CAB represents the gain in consumer surplus, $P^d_1P^d_0EF$, minus the loss in producer surplus, $P^s_1P^s_0AC$. This is easy to see in the case of a unit tax because (P^s_o - P^s_1) must equal (P^d_o – P^d_1). Hence, the area $P^d_1P^d_0EF$ must equal $P^s_1P^s_0AB$.

The area AEFB is equal to $T(Q_d-Q_0)$ or the net gain in government revenue that results from the increased demand. The gross economic value of the output is therefore equal to the financial value plus the change in government tax revenues plus the increase in the consumer surplus minus the loss in producer surplus. Consumers gain as a result of the lower price of the good. Producers lose because of the fall in price and reduced production; and the government collects more tax revenues, because of the expansion in the quantity demanded due to the lower price.

[7] The illustration in this case is for a unit tax, but the same results also hold for ad-valorem taxes imposed on goods or services. The computation is somewhat more involved.

Figure

FINANCIAL AND ECONOMIC VALUES FOR PRODUCTION OF NON -TRADED GOOD WITH A UNIT TAX



In summary, when the market is distorted only by a unit tax, the gross economic value of the output of a project can be expressed as,

Economic Value of output = Financial Value of output + Change in Government Tax Revenues + Increases in Consumer Surplus - Loss in Producers Surplus

The Case of An Importable Input That is Subject To Tariff

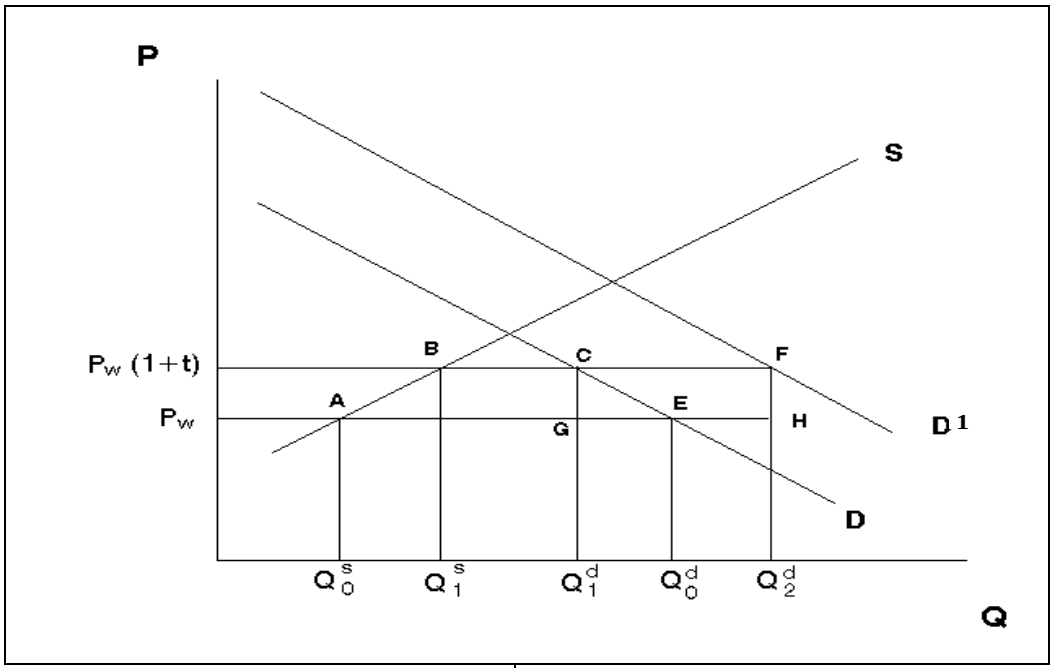
In Figure below, the case of an importable good is illustrated where the inputs of the item are subject to a tariff at a rate of t. The CIF price is P_w and the domestic price is $P_w(1+t)$. The initial market equilibrium is found at the domestic price of $P_w(1+t)$ where the quantity demanded is Q^d_1 and the quantity supplied by domestic producers is Q^s_1. The quantity imported is $(Q^d_1-Q^s_1)$. The CIF price is P_w. A new project now demands an additional quantity of this item as an input. This addition to demand is shown in Figure below, as a shift in the market demand curve from D_0 to D_1.

Because it is an importable good, this increase in demand will lead to an equal increase in the quantity of the item imported of (Q^d_2-Q^d_1). The financial cost of the additional imports is $P_w(1+t)$ (Q^d_2-Q^d_1), while the economic cost is equal to $P_w(Q^d_2-Q^d_1)$ (E_e/E_m); where E_e is the economic exchange rate and E_m is the financial market exchange rate.

The difference between the economic and financial costs of the importable good can be expressed as $[E_e/E_m - 1]P_w$ (Q^d_2-Q^d_1) – t P_w (Q^d_2-Q^d_1). The first term of this expression is the rate of foreign exchange premium $[E_e/E_m - 1]$ times the cost of the inputs purchased at world prices P_w. This measures the externality, usually tariff revenues foregone, from the use of foreign exchange to purchase the input. Tariff and taxes would have been paid if the foreign exchange required for this purchase had been used to purchase other imports. The second expression is the tariff revenues paid by the project when it imports these inputs.

The net distributional impact on the government is the difference between the two effects. The government gains revenue as a result of the imposition of the tariff, but loses because the use of the foreign exchange elsewhere also would have yielded some tariff revenues. (In the case of a quota, those who have import licenses are the beneficiaries of the premium on foreign exchange).

Figure
MEASURING DISTRIBUTIVE IMPACT FROM FINANCIAL AND ECONOMIC VALUES OF INPUTS WITH TARIFFS



In summary, for the case of an importable good subject to a tariff, the economic cost of the item can be expressed as follows:

Economic cost of importable input =

Financial cost – gain to the government from the tariff revenues paid on the purchase of the item +loss in government revenues due to the foreign exchange premium on the foreign exchange used to purchase this input.

Thus, if each of the values for the input and output variables that make up a project are broken down into their economic, financial and distributional components, then the end result can be expressed as in equation (1) where the net present value economic is equal to the net present value of the financial outcome of the project, plus the present value of a series of distributional impacts on the various stakeholders of the project.

Appendix 6: Opportunity Cost of Foreign Exchange

Introduction

In project appraisal, there are two important national parameters. The first national parameter is the economic opportunity cost of capital, which measures the economic opportunity cost of using the capital resources in the specific project rather than in alternative uses in the economy. If there are distortions in the capital markets, such as taxes and subsidies, then there will be a discrepancy between the financial cost of capital that is applied to the cash flows in the financial analysis and the economic cost of capital that is applied to the corresponding economic cash flows for the investment project. The methodology to estimate this is outlined in Appendix B.

The second national parameter is the economic opportunity cost of foreign exchange. Distortions in the markets that determine the supply and demand of foreign exchange (commonly, trade and other indirect taxes on tradables) also result in the economic exchange rate differing from the financial (official or market) exchange rate. Typically these distortions result in the economic value of the foreign exchange being higher than the financial value of the foreign exchange, in which case there is a positive foreign exchange premium. Trade taxes and taxes on consumption (such as sales taxes, VAT or excise duties), importantly, tend to reduce the market demand for imports which, in turn, reduce the demand for foreign exchange. This results in the strengthening in the market exchange rate or a positive foreign exchange premium. (The effects of tax distortions are elaborated further below.) In the calculations of the conversion factors for the converting line items in the financial analysis to their economic values, we have to take into account the value of the foreign exchange premium. If, for example, there are traded inputs (or outputs) in the project, then the value of the traded inputs (or outputs) must be adjusted for the economic opportunity cost of foreign exchange in the presence of trade distortions to the extent that the use (or production) of these traded goods results in added demand for (or supply of) of foreign exchange.

In some countries with controlled exchange rates, there may be a parallel market for foreign exchange. In the parallel market, the "black market" exchange rate may be higher than the official exchange rate. As a first approximation, in the absence of any other information, the difference between the exchange rate in the parallel market and the official exchange rate is probably an underestimate of the foreign exchange premium as it excludes the component arising from tax and subsidy distortions.

Generally the project analyst does not have the expertise, experience, resources or time to conduct a reliable estimation of these national parameters. Typically, the appropriate government agencies will provide guidelines or estimates for national parameters. Ideally, for example, foreign exchange premium estimates should be derived from a fairly disaggregated general equilibrium model of the economy that captures the major distortions affecting the foreign exchange market. However, it is important for the project analyst to be comfortable with the principles behind the estimation of the two national parameters and how they relate to the overall economic appraisal of the investment project. For Iraq, some rough calculations suggest that the

foreign exchange premium is approximately 12%.[47]

Simple example of effect of a trade distortion

In this section, we provide an informal introduction to the economic opportunity cost of foreign exchange. To illustrate the key concepts concerning the role of trade in the foreign exchange market, we begin with a simple numerical example. Then we present an informal introduction to the underlying theoretical framework for estimating the economic opportunity cost of foreign exchange by examining the market for foreign exchange.

Consider a simple case in which the only domestic distortion on the importation of a machine required for a project is an import tariff of 20%. Suppose the machine costs Iraqi Dinar 10.8 million in the domestic market. It does not matter whether the machine is imported or its (comparable) equivalent is produced domestically. The key question is whether the machine is tradable on the world market. Also, we have to examine the final impact of the project's demand for an additional unit of the machine. In other words, it does not matter whether our specific project imports the machine. As explained below, what matters is the **final** impact in the market for imported machinery.

If the project imports the machine, then the quantity of imported machines in the economy increases by one unit. However, if the project purchases a comparable machine that is produced domestically, it means that another project would not be able to purchase that comparable machine. And therefore, that other project would have to import a machine. The final impact of the demand by the project for the machine leads to a unit increase in the number of imported units in the economy even though our project may not purchase an imported machine.

Numerical example

We have assumed that the imported machine and the machine that is produced domestically are comparable. Consequently, in competitive markets, the market prices for the two machines are the same. In domestic currency, the price of the machine is Iraqi Dinar 10.8 million. We assume that the foreign exchange rate is Iraqi Dinar 45/US$. In foreign currency, the price of the machine is US$ 240,000, inclusive of an import tariff of 20%. The CIF price of the machine, excluding the import tariff, is US$ 200,000.

If there were no tariff, then the price of the machine would be the CIF price, which is the world price. However, the tariff provides protection to the domestic producers who price the machines at the world price plus the import tariff. The project has a choice. At the **same** price, the project can either buy the imported machine at the CIF price plus the import tariff, or the domestically produced machine.

The financial price of the machine is Iraqi Dinar 10.8 million. The economic value of the machine is the world price of Iraqi Dinar 9 million, exclusive of the import tariff. If there were no tariff, then the project could

[47] Rough estimates of the foreign exchange premium (FEP) in Iraq arising from trade taxes and other indirect consumption taxes, show that it has dropped from around 30% in 1990 to around 20% by the later half of the 1990s and further to around 11% to 12% by 2004. This drop has primarily come about with the reduction in import duties on international trade and the major expansion in international trade as a share of the GDP as the Iraq economy has been opened up over the past decade. By contrast the contribution of domestic consumption taxes to the FEP has remained steady in the range of about 6% to 7%.

have purchased the machine for Iraqi Dinar 9 million. Thus, the economic opportunity cost of the machine is Iraqi Dinar 9 million, which is the world price of the machine.

Up to this point, we have not discussed the economic value of the foreign exchange. The foreign exchange component of the machine equals the value of the machine at the world price or the amount of foreign exchange resources the economy has to forgo to get an additional machine. Therefore, the incremental demand for US$ that is US$ 200,000. The import duty of $40,000 is a transfer from the importer to the government and is not an economic cost. However, there may be other distortions in the foreign exchange market, which means that there might be a foreign exchange premium. Assume that the foreign exchange premium is 12%. This means that the economic value of the foreign exchange is higher than the CIF by 12% and the economic value of the machine equals US$ 224,000.

The details of the calculations are shown in the table. This reviews the main concepts just covered. The financial cost of the machine is Iraqi Dinar 10.8 million (in domestic currency) or US $240,000 (in foreign currency).

Table 1: Financial and economic costs of the machine

	Fin Value	**CF1**	**Econ Val**	**CF2**	**Econ Val**
Machinery, CIF, US$, '000	200.00	1.00	200.00	1.12	224.00
Import duty	40.00	0.00	0.00	0.00	0.00
Market price, US$, '000	240.00	0.833	200.00	1.12	224.00

Machinery, CIF, Iraqi Dinar (Millions)	9.00				10.08
Import duty, Iraqi Dinar (Millions)	1.80				0.00
Market price, Iraqi Dinar (Millions)	10.80				10.08

Conversion factor (intermediate)	0.833
Final conversion factor	0.833* 1,12 = 0.933

The economic cost of the machine, without taking into account the foreign exchange premium, is Iraqi Dinar 9 milliions (in domestic currency) or US$ 200,000 (in foreign currency). The economic cost of the machine, taking into account the foreign exchange premium, is Iraqi Dinar 10.08 millions (in domestic currency) or US$ 224,000 (in foreign currency).

The final conversion factor, which is the ratio of the economic price of Iraqi Dinar 10.08 million to the financial price of 10.80 million, is 0.933 or CF1 times CF2 (or 0.833*1,12).

Market for foreign exchange

As stated earlier, to analyze and understand the market for foreign exchange, we use the **same** analytic framework that we had used for estimating the economic value of non-traded goods. Even though foreign currency is a medium of exchange, we can view it simply as a good called "foreign exchange" with a market equilibrium that is determined by demand and supply curves.

To calculate the economic price for one unit of foreign exchange, we have to take into account the distortions in the foreign exchange and related markets, in the same way that we had calculated the economic price for a non-traded good. In addition to import duties, export taxes, domestic consumption taxes and other quantitative trade restrictions, there might be controls on the free movement of currencies as well.

We apply the three postulates of welfare economics to the market for foreign exchange. On the demand side, the demand curve for foreign exchange measures the willingness to pay of the demanders, which in turn is an estimate of the benefits to the consumers. On the supply side, the supply curve for foreign exchange measures the value of the resources that are required to generate the foreign exchange.

The demand and supply curves for foreign exchange depend on the corresponding trade activities that generate the demand and supply for the foreign exchange. On the demand side, the demand for foreign exchange is derived from the market for importables, where the quantity of foreign exchange demanded equals the value of imports. In turn, the quantity of imports equals the difference between the demand for importables and the supply of importables, and is a function of the exchange rate.

On the supply side, the supply of foreign exchange is derived from the market for exportables, where the quantity of foreign exchange supplied equals the value of exports. In turn, the quantity of imports equals the difference between the demand for importables and the supply of importables, and is a function of the exchange rate.

To clarify some terminology that is used to describe the movement of exchange rates, suppose the exchange rate were to increase from Iraqi Dinar 45/US$ to Iraqi Dinar 50/US$. The increase in the exchange rate could arise from either an increase in the demand for foreign exchange (demand curve moves right), or a decrease in the supply of foreign exchange (supply curve move left). The *higher exchange rate* means that the *domestic currency has depreciated*. There is an inverse relationship. It has gone down in value because now more units of domestic currency are required to buy one unit of the foreign currency.

Conversely, suppose the exchange rate were to decrease from Iraqi Dinar 45/US$ to Iraqi Dinar 40/US$. The decrease in the exchange rate could arise from either a shift to the left of the demand curve, or a shift to the right of the supply curve. In this case, the *lower exchange rate* means the *domestic currency has appreciated*. It has become stronger because now we need fewer units of domestic currency to buy one unit of the foreign currency.

We present the estimation of the economic opportunity cost of foreign exchange in two stages. First, we assume that there are no distortions. Second, we introduce the distortions.

Economic opportunity cost of foreign exchange without distortions

If a project demands foreign exchange, say for importing machinery, then the demand curve for foreign exchange shifts to the right. The economic opportunity cost of foreign exchange is a weighted average of the economic values of the demand and supply responses.

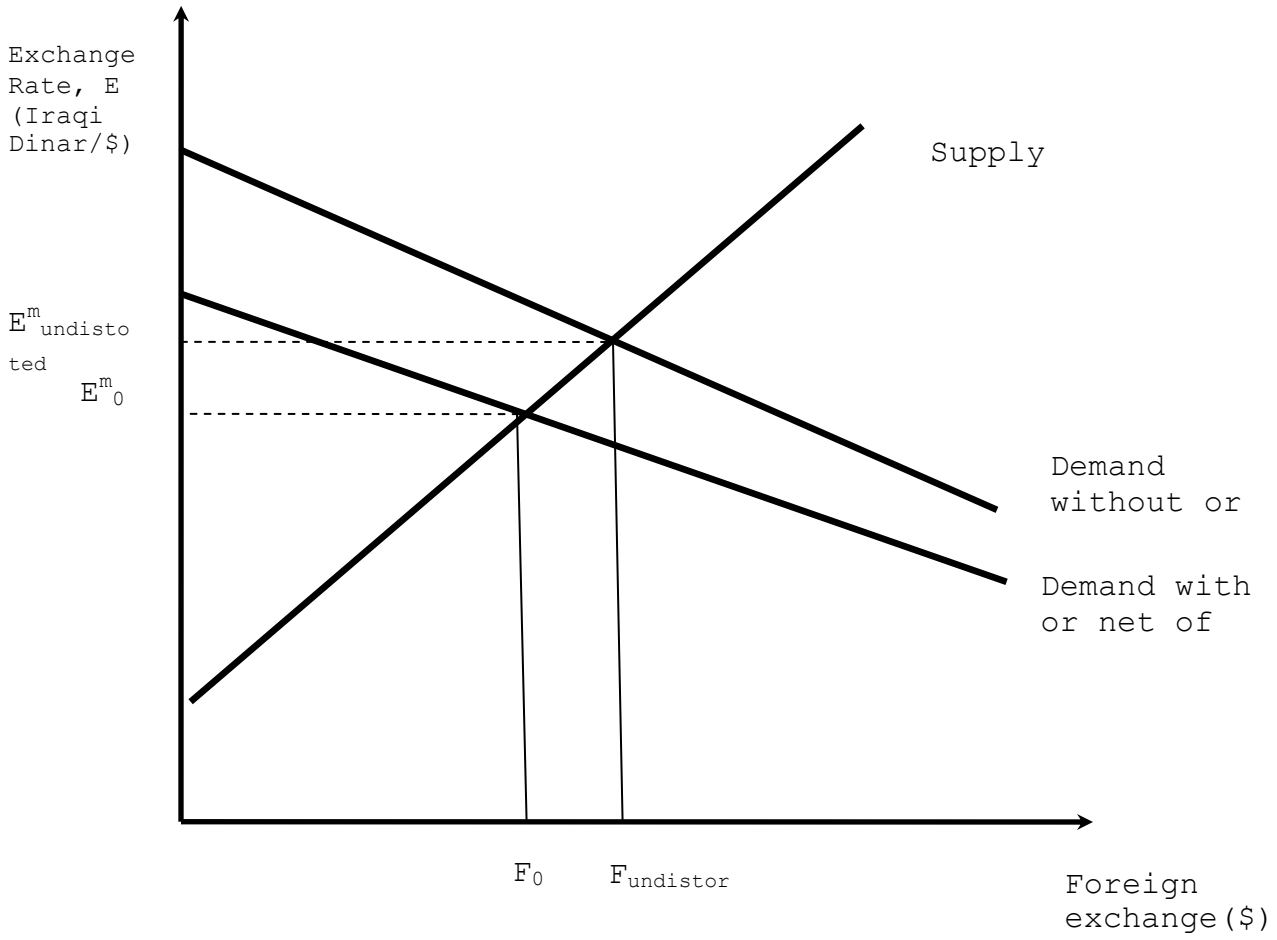
Similarly, if a project supplies foreign exchange, say by exporting an output produced by the project, then the supply curve of foreign exchange shifts to the right. Again, the economic opportunity cost is a weighted average of the economic values of the supply and demand responses.

As expected, with no distortions in the foreign exchange market, the economic opportunity cost of foreign exchange equals the financial cost of foreign exchange. In Figure F.1 below, in an undistorted market, the market would equilibrate at an exchange rate $E^m_{undistorted}$ with the quantity of foreign exchange being traded per period at $F_{undistorted}$. Increases in the demand for or supply of foreign exchange would result in an economic opportunity cost of foreign exchange, $E^e = E^m_{undistorted}$, as just discussed, or the weighted average of the cost of added foreign exchange supplied from the exportable market or bid away from the importable market would approximate the market exchange rate.

If import duties are imposed on imports and various consumption taxes imposed on domestic demand for goods and services (such as sales taxes, VAT, excise duty, service taxes, etc) then the domestic demands for imports, importables and exportables decline. This effectively decreases the demand for imports and foreign exchange and makes more exportables available to earn foreign exchange from exports. The combined effect of the decreased demand for foreign exchange and the increased supply of foreign exchange is to cause the exchange rate to appreciate. Figure F1 below captures this combined effect as an effective tax on foreign exchange. The exchange rate decreases or appreciates from $E^m_{undistorted}$ to E^m_0, while the quantity of foreign exchange falls from $F_{undistorted}$ to F_0.

Now with tax distortions affecting the foreign exchange market the concept of the economic opportunity cost of foreign exchange can be addressed in a similar fashion to the economic price of non-traded goods.

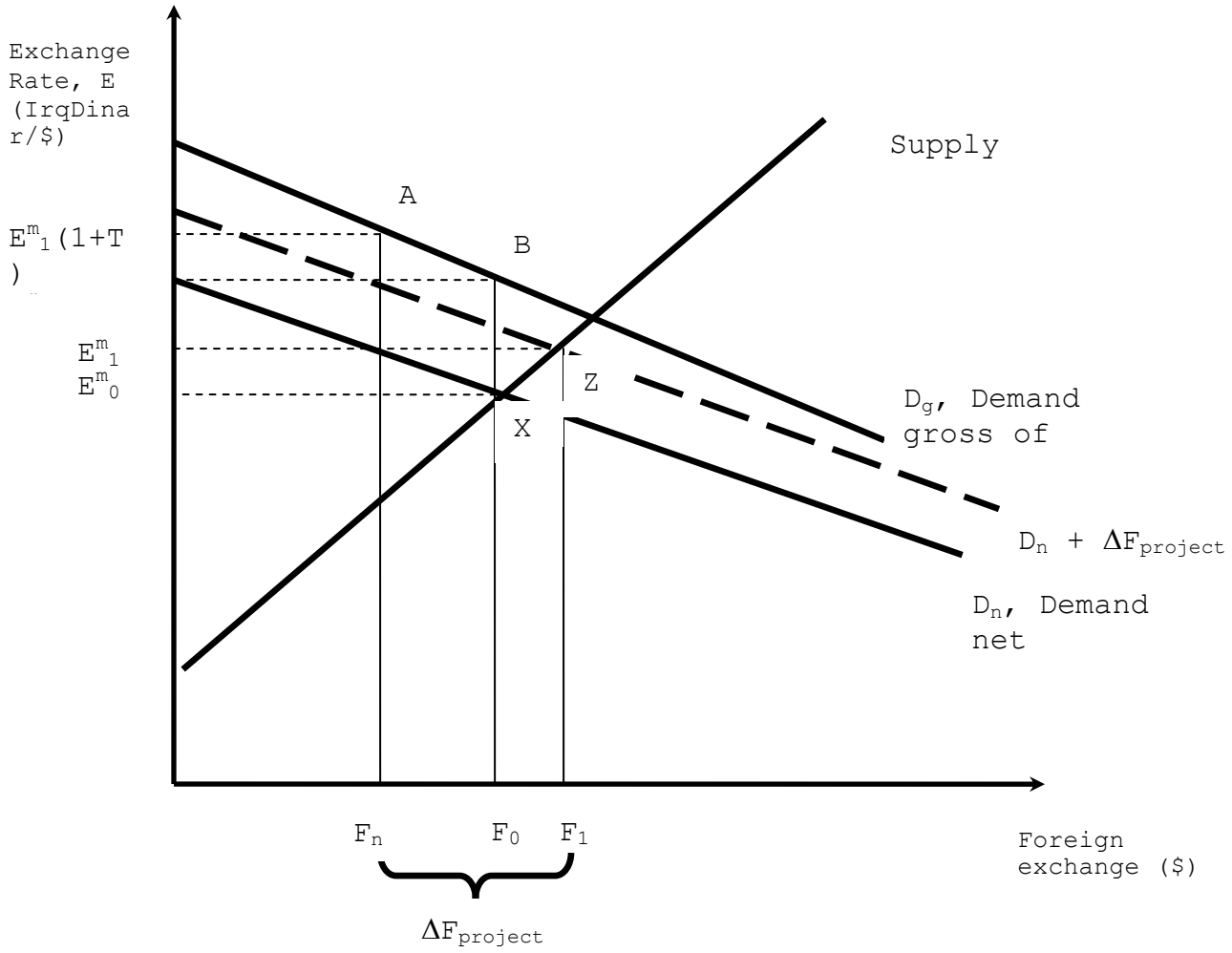
Figure F.1 Market for foreign exchange with import duties and domestic consumption taxes



Economic opportunity cost of foreign exchange with distortions

With an effective tax on the use of foreign exchange at rate T arising from import duties and domestic consumption taxes, the effective market demand curve becomes D_n in Figure F2. The market equilibrates at exchange rate E^m_0, and quantity of foreign exchange traded, F_0. Now if a project demands added foreign exchange, $\Delta F_{project}$, the effective market demand curve shifts to the right and the market exchange rate rises to E^m_1 and the foreign exchange traded rises to F_1. Importantly, however, the expansion of the foreign exchange market caused by the added demand is less than $\Delta F_{project}$. Part of the demand is sourced from added supply ($F_1 - F_0$) from added exports induced by the increase in the market exchange rate, while the remainder ($F_0 - F_n$) is sourced from a reduction in imports as the exchange rate rises such that some businesses forgo the use of foreign exchange. In other words, a share (W^S) of $\Delta F_{project}$ is sourced from added supply of foreign exchange, or ($F_1 - F_0$) = $W^S \Delta F_{project}$, and the remaining share (W^D = 1- W^S) comes from forgone demand for foreign exchange, or ($F_0 - F_n$) = $W^D \Delta F_{project}$.

Figure F.2 Economic opportunity cost of foreign exchange in a market with import duties and domestic consumption taxes



The economic cost of the foreign exchange used by the project is therefore the sum of the costs of the added foreign exchange supplied and the cost of the forgone foreign exchange demanded. From Figure F2, the cost of the added foreign exchange supply is given by cost of the resources used to generate this supply or the area under the supply curve, F_0XZF_1, while the cost of the forgone foreign exchange demand is the area under the gross of tax demand curve (which measures the full domestic willingness to pay for foreign exchange including the taxes), F_nABF_0. The economic opportunity cost of a unit of foreign exchange, E^e, then is the sum of these two areas divided by the quantity demanded by the project, $\Delta F_{project}$. If the rise in the market exchange rate is taken to be small and $E^m_0 \approx E^m_1$, then the

economic cost of the foreign exchange demand can be expressed as:

$$\Delta F_{project}\ E^e = W^S \Delta F_{project}\ E^m_0 + W^D \Delta F_{project}\ E^m_0(1 + T)$$

Or the economic exchange rate per unit of foreign exchange as:

$$E^e = W^S E^m_0 + W^D E^m_0(1 + T)$$

where E^e is the economic exchange rate or the economic opportunity cost of foreign exchange,

E^m_0 is the market price of foreign exchange

T is the effective tax rate on foreign exchange

W^S is the weight of the supply response and

W^D is the weight of the demand response

The foreign exchange premium, FEP, gives the relative excess of the economic exchange rate over the market exchange rate, or

$$FEP = (E^e - E^m_0)/E^m_0$$

$$= W^D T$$

In other words, FEP gives the rate at which added taxes are forgone per added unit of foreign exchange used. If the market exchange rate is IrqDinar 45/$ and the FEP is 12%, then E^e = Iraqi Dinar 50.4/$ and each US dollar of foreign exchange used (produced) by the project loses (gains) the economy an added Iraqi Dinar 5.4 (or 12% of Iraqi Dinar 45/$) in tax externalities.

Actual estimates of the FEP should be based on a general equilibrium model that recognizes that the tax distortions in the economy that are summarized in the effective tax rate on foreign exchange, T, above, actually are distributed across a number of markets that are affected by changes in the market exchange rate arising from added demand or supply of foreign exchange by a project. The tax externalities arise from changes in the taxes induced by the following market responses to an increase in the market exchange rate as a result of a project demand for foreign exchange:

1. Decline in the demand for imports as the supply of importables increases and the demand for importables decreases causing a loss in import duties
2. Decline in the demand for importables and exportables causing a loss in consumption taxes (such as sales taxes, VAT, excise duties, and service taxes)
3. Increase in exports as the supply of exportables increases and the demand for exportables decreases causing an increase in any export taxes
4. Decrease in the supply of non-tradables as the rising price of tradables attracts resources into the production of exportables and importables and away from non-tradables causing a loss in domestic consumption taxes.

A crude estimate of the FEP arising from these effects of indirect taxes can be gained from the following:

$FEP = M/(M+X).T_m + (0.3T_m + 0.75)V$

Where: M = Value of imports of goods and services

X = Value of exports of goods and services

T_m = Effective import duty rate, or import duties over import value of goods and services

V = Effective domestic consumption tax rate, or domestic consumption taxes over final demand

Based on revenue and macro-economic data for Iraq through 2004, FEP is approximately 12%.

Appendix 7: Economic Discount Rate

Why is the Economic Cost of Capital Important?

Project appraisal requires a comparison of the costs and benefits of a project over its life. For acceptance, the present value of the project's benefits should exceed the present value of its costs. In the case of mutually exclusive projects, its net present value (NPV) also should be greater than those of the alternative projects.[48] The economic opportunity cost of capital is also an important parameter for taking decisions relating to the optimum size of the project and the appropriate timing for making an investment. Both are critical factors affecting the net benefits and the project's ultimate viability. In addition, the choice of technology for a project is influenced by the opportunity cost of capital. A low cost of capital will encourage the use of capital-intensive technologies as opposed to labor- or fuel- intensive technologies. In the case of Iraq, the situation may be the other way around, where the cost of capital can be high, and therefore labor intensive technology should be encouraged.

(i) Opportunity Cost of Capital and Investment Criteria

When the net present value (NPV) is used as an investment criterion, it is the net benefits, which occur over time that must be compared for alternative projects. As the resources available today may be used for investments, yielding positive returns, or alternatively may provide goods and alternative services for immediate consumption, it is necessary to give a greater importance to benefits and costs that accrue earlier and a lower weight to those that accrue in later periods.

In applying the NPV criterion in economic analysis, the values of net benefits should be discounted to a common point in time before comparison. This is done using the economic opportunity cost of capital as the discount rate. When this discount rate is used, a positive net present value means that the project in question has a greater economic return than would otherwise be produced by the standard alternative use of the same funds.

(ii) Choosing the Scale of a Project

An important decision in project appraisal concerns the size or scale at which a facility should be built. It is seldom that the scale of a project is constrained by technological factors, and economic considerations should be paramount in selecting its appropriate scale. Even if the project is not built to its correct size, it may be a viable project, i.e. its NPV may still be positive, but less than its potential. The NPV is maximized only when the optimum scale is chosen.

The appropriate principle to use for determining the scale of a project is to treat each incremental change in size as a project in itself. An increase in the scale of a project will require additional expenditures and will generate additional benefits. The net present value of the costs and benefits of each incremental change should be calculated by using the economic discount rate.

The NPV of each incremental project indicates by how much it increases or decreases the overall net present value of the project. This procedure is repeated until a scale is reached where the net present value

[48] M. Roemer and J.J Stern, The Appraisal of Development Projects, (New York: Praeger Publisher, Inc., 1975).

of incremental benefits and costs associated with a change in scale changes from positive to negative. When this occurs, the previous scale is the optimum size of the plant. Thus, the economic opportunity cost of capital or economic discount rate is central to the selection of the optimum scale of a project.

(iii) Timing of Investment

Another important decision to be made in project analysis relates to the appropriate time for a project to start. A project that is built too soon could result in a large amount of idle capacity. In this case, the forgone return from the use of funds elsewhere might be larger than the benefits gained in the first few years of the project's life. On the other hand, if the project is delayed too long, shortages may occur and the forgone benefits of the project will be greater than the alternative yields of the invested funds.

Whenever the project is undertaken too early or too late, its net present value will be lower than what it could have been if developed at the right time. The net present value may still be positive, but it will not be at the project's potential maximum.

The key to making a decision on this issue is whether the costs of postponement of the project are greater or smaller than the benefits of postponement. For example, in a situation where a project's potential benefits, net of operating costs, are growing as a function of calendar time but its real investment costs are the same, irrespective of the date of initiation of the project, the costs of postponement from year t to year t+1 are the economic benefits B_{t+1} forgone by delaying the project. The benefit of postponement is the economic return (r_e) that can be earned from the capital invested in its alternative use. Thus the benefit from postponement is equal to the economic opportunity cost of capital multiplied by the capital costs, $r_e \times K_t$.

A value for the economic opportunity cost of funds is essential in choosing the correct time for starting the project.

(iv) Choice of Technology

In order to be worth doing, a public sector project must have a rate of benefit of yield that is at least as large as the economic opportunity cost of capital. If this is not so, the capital would better be left to be allocated to other uses through the normal working of the capital market.

Sometimes public sector projects face a financial cost of capital that is artificially low. This may happen when they can raise debt capital at an artificially low rate of interest because of government subsidies or guarantees. Alternatively, public sector projects may receive tax concessions from the government. In either case, the cost of capital perceived by the project will be below its economic opportunity cost.

The use of a lower financial cost of capital instead of its economic opportunity cost would create an incentive for the project managers to use production techniques that are too capital intensive, which may not be beneficial for the Iraqi states. The choice of an excessively capital-intensive technology would also lead to economic inefficiency because the value of the marginal product of capital in this activity is below the economic cost of capital to the country. For example, in electricity generation, using a financial cost of capital that is lower than its social cost will make capital-intensive options such as distant hydroelectric dams or nuclear power plants more attractive than oil- or coal-fired generation plants. A correct measure of the economic opportunity cost of

capital is, therefore, necessary for the right choice of technology.

This appendix describes the methodology and provides an empirical estimation of the economic cost of capital in Iraq. For the purpose of evaluating investment projects, this national parameter should be used to discount the net economic benefit stream arising from an investment in order to derive its economic net present value. The empirical results indicate that the real economic cost of capital is approximately 12 % for the country. Hence, the rate of 12 percent is recommended for the economic discount rate in Iraq.

Methodology for Estimating the Cost of Capital

Different approaches have been used to determine the economic cost of capital.[49] One of the practical ways to measure this parameter is to use the economic opportunity cost of public funds where the funds will be drawn from various sectors of the economy according to their response to changes in interest rates due to borrowing in capital markets.[50] In a developing economy like Iraq, there are normally three alternative sources for these public funds. The first source comes from those resources that would have been invested in other investment activities, but those other activities have been either displaced or postponed. Another alternative source is from individual savers whose resources would have been spent on private consumption, but the consumption is forgone due to an increase in domestic savings. The third source is additional foreign capital inflows.

Based on these three alternative sources of public funds, the economic cost of capital (EOCK) can be estimated as a weighted average of the rate of return on displaced or postponed investments, the rate of time preference to savers, and the cost of additional foreign capital inflows. It can be expressed in the following form:

$$EOCK = f_1 \bullet \pi + f_2 \bullet \gamma + f_3 \bullet MC_f \quad (1)$$

where π = the economic cost of funds drawn from the displaced investment

γ = the rate of time preference

MC_f = the cost of foreign savings

The economic cost of funds drawn from the displaced investment (π) is measured by the forgone gross-of-tax return to domestic capital, the rate of time preference (γ) is the cost of postponed consumption due to the response by households to save more, and the cost of foreign savings (MC_f) is valued at marginal cost of foreign borrowing by the government. The corresponding weights (f_1, f_2, and f_3) are the proportions of funds diverted or sourced from each sector, and $f_1 + f_2 + f_3 = 1$.

These weights can be expressed in terms of elasticities of demand and supply of funds with respect to changes in financial costs or rate of return. Parameter f_1 may be shown as:

[49] See, for example, Sell, Axel, "Project Evaluation: An Integrated Financial and Economic Analysis" (Avebury, England 1991), Part III.3,
Hirshleifer, Jack, DeHaven, James C., and Milliman, Jerome W. "Water Supply: Economics, Technology, and Policy" (Chicago: University of Chicago Press,1960)
Little I.M.D. and Mirrlees J.A., "Project Appraisal and Planning for Developing Countries" (London, Heineman Educational Books Ltd., 1974)

[50] A.C. Harberger, "On Measuring the Social Opportunity Cost of Public Funds", Project Evaluation -- Collected Papers, (Chicago: the University of Chicago Press, 1972), Chapter 4.

$$\frac{\eta}{\varepsilon_r(S_r/S_t)+\varepsilon_f(S_f/S_t)-\eta}$$

Parameter f_2 may be shown to be equal:

$$\frac{\varepsilon_r(S_r/S_t)}{\varepsilon_r(S_r/S_t)+\varepsilon_f(S_f/S_t)-\eta}$$

Parameter f_3 may be shown to be equal:

$$\frac{\varepsilon_f(S_f/S_t)}{\varepsilon_r(S_r/S_t)+\varepsilon_f(S_f/S_t)-\eta}$$

Where: ε_r = the supply elasticity of household savings

ε_f = the supply elasticity of foreign funds

η = the elasticity of demand for capital relative to changes in the interest rate

S_t = the total saving available in the economy

S_r = the contribution to the total savings by households

S_f = the total contribution of net foreign capital inflows.

There are more than one group of investors and savers. Therefore, the elasticities ε_r, ε_f and η used in the equation are the weighted average of elasticities for the various groups of savers and investors.

Expressing f_1, f_2, and f_3 by the weights in terms of elasticities of funds, equation (1) can then be rewritten as follows:

$$EOCK = \frac{\varepsilon_r(S_r/S_t)\bullet\gamma+\varepsilon_f(S_f/S_t)\bullet MC_f-\eta\bullet\pi}{\varepsilon_r(S_r/S_t)+\varepsilon_f(S_f/S_t)-\eta} \quad (2)$$

Appendix 8: Economic Opportunity Cost of Labor

The Economic Opportunity Cost of Labor (EOCL) is the value to the economy of the set of activities given up by the workers including the non-market activities (costs and benefits) associated with changes in employment due to the project. It may be noted that labor is not a homogeneous input; there are many different types of skilled and unskilled labor, with both regional variations and distinct sectors (protected and unprotected). The quality of employment opportunities (permanent and temporary) also affect the EOCL.

(A) Estimation of the Economic Opportunity Cost of Labor

There could be two alternative starting points:

i) Value of marginal product of labor foregone, and

ii) Supply price of labor.

Using either method will theoretically produce the same result; data requirements for the two approaches, however, are quite different.

(i) Value of Marginal Product of Labor Foregone Approach

In this approach, the EOCL is determined by starting with the gross-of-tax alternative wage (W_a) earned in previous employment. There are two problems with this approach.

- Method not suited to accounting for differences in working and living conditions which do not directly reduce output in the economy.
- When hiring unemployed labor, it may lead to underestimation of EOCL.

(ii) Supply Price of Labor Approach

The supply price of labor approach is straightforward and easy to use.

- Starting point is the gross-of-tax market wage (the supply price) required to attract sufficient workers of the required skill level to work on the project. That wage also accounts for worker's preferences for location, working conditions and other factors.
- If a very high local market wage is required to attract skilled labor to a project where the living conditions are bad, that wage already includes value of foregone wages plus the compensation needed for economic costs inflicted by the bad living conditions on the workers.
- Supply price needs to be adjusted to account for other distortions, such as taxes etc. to arrive at the EOCL.

Unlike the marginal product foregone which measures both these components separately, the local supply price directly measures the wage and non-wage costs of employment by the project as a combined package and that is the economic opportunity cost labor of working on the project.

Supply price determined by asking the question: What is the minimum wage the project must pay to get an adequate number of applicants with an acceptable turnover? If the number of applications per job is high, and turnover rate for the project is abnormally low, wage rate paid is most likely to be above the minimum supply price. If the ratio of qualified applicants to vacancies represents a fairly tight labor market, and turnover rate is normal, project wage is close to supply price of labor.

EOCL is calculated by adjusting minimum supply price to account for distortions such as income taxes or subsidies.

Example 1: Comparing the Value of Marginal Product Foregone and Supply Price Methods

Consider the case of unskilled farm workers who move from their previous job of picking apples in cold, rainy apple growing region (a) to work on a new project in warmer climate (o) of harvesting oranges.

Starting point for calculating the EOCL using the marginal product foregone approach is the prior wage on the apple farms (W_a), while the supply price approach would begin with the market wage for work in the orange groves (W_o). For simplicity, assume that the workers do not pay income taxes or face any other significant distortions in their labor market. Other factors that would influence the decision to relocate to the new project are: the warmer climate of the orange growing region that might translate into a reduced cost of living (C) or a preference (S) of the workers to work in a warmer region.

If values of the wage and other factors are assumed to be as follows:

W_o = \$ 15.00 per day
W_a = \$ 20.00 per day
C_o = \$ 3.00 per day
C_a = \$ 6.00 per day
S_o = \$ 2.00 per day (value of the preference for warmer region)

Marginal product foregone method to calculate EOCL for the project yields:
EOCL = prior wage - change in cost of living - worker preferences
$= W_a - (C_a - C_o) - S_o$
$= 20 - (6 - 3) - 2$
Or EOCL = \$15.00 per day

With supply price approach, same value reached directly. The market wage necessary to induce workers to move to new project in orange growing region (W_o) is known and already accounts for the cost of living difference ($C_a - C_o$) and worker's preference for warmer climate (S_o). EOCL simply equal to market wage in the region of the new job:
EOCL = W_o = \$15.00 per day

Usually, it is difficult to place values upon complex factors such as cost of living differentials and workers' preferences for living conditions etc.

(B) Different categories of labor and accounting for these differences:
1. Type of skill: skilled, unskilled
2. Regional Variation: rural, urban
3. Labor market segmentation: Unprotected vs. Open
4. Type of Job: Permanent vs. Temporary

The unskilled labor is usually homogeneous and estimating its EOCL is quite straightforward. Normally distortions such as taxation or unemployment insurance are absent. But the skilled labor market is much more heterogeneous and subject to multiple distortions.

Regional migration induced by differences in wages, cost of living, access to consumer goods, etc. also affects the EOCL for a project. Distortions in the economy related to that migration needs to be accounted for when estimating EOCL.

Urban labor markets are often segmented into protected (employees of SOEs, large industries or multinational corporations sectors) and those where wages are set competitively (unprotected or open sector).

Estimation of EOCL for a project also needs to consider whether permanent or temporary employment will be created. Temporary

positions (tourism, construction) lead to greater turnover and create conditions for voluntary unemployment and thus causing additional costs to the economy.

II. The Economic Opportunity Cost of Unskilled Rural Labor

Supply Price Approach - Three steps are involved:
(i) Determine the minimum gross-of-tax wage (W) needed to attract sufficient unskilled labor;
(ii) Identify distortions in the labor market such as income taxes or unemployment insurance benefits;
(iii) Determine EOCL by adjusting for distortions.

Several cases may arise in this group.

Case I : No seasonal variations in the market wage and no distortions in the unskilled labor market. It follows that supply price of labor equals the prevailing market wage (W^u). No need to make further adjustments because there are no distortions.

(1) $EOCL^u = W^u$ = Supply Price of Unskilled Labor

Case II: Estimation of EOCL of unskilled labor for a project where demand of workers is same throughout the year while the market wage varies due to external factors affecting labor market. If no tax distortions, the EOCL is the average of the monthly or weekly market wage rates (W^u_i) for the duration of the project.

$$(2) \qquad EOCL^U = \sum_{i=1}^{n} L_i W^u_i \Big/ \sum_{i=1}^{n} L_i$$

where:
n = the number of periods over which the EOCL is being estimated
i = the period of time
L_i= the number of people employed during period i.

Seasonal variations: It is quite common to have seasonal variation in the size of the employed work force in rural areas. In this case, EOCL is a weighted average of the different unskilled wage rates throughout the year.

This equals the sum of unskilled wage rate for each particular season or wage period (W^u_i) times the proportion (K_i) of the total amount of unskilled labor employed by the project in that period.

As $K_i = L_i / \sum_{i=1}^{n} L_i$ (Eq. 2) can be rewritten as:

$$(3) \qquad EOCL^u = \sum_{i=1}^{n} (K_i W^u_i)$$

where: n = the total number of periods; i = the period of time.

Example 2: Sugar Factory hires Unskilled Labor in a Rural Area

A labor-intensive sugar project requires unskilled workers on a temporary basis and pays a wage of 180 dollars per month (W^u_p). The working conditions are identical to those prevailing in the labor market. Table 1 (column 3) shows the project's monthly requirements for person-months and in column (2) the monthly market wage rates (W^u_i) that agricultural labor would be willing to work for this project.

TABLE 1

Month	Mkt. Wage W^u_i in $/month	Person-months reqd. by proj.	Share of Annual Person months (K_i)
(1)	(2)	(3)	(4)
January	120	1,800	0.2
February	100	1,800	0.2
March	180	1,800	0.2
April	180	900	0.1
May	100	900	0.1
June	150	0	0.0
July	180	0	0.0
August	120	0	0.0
September	150	0	0.0
October	110	0	0.0
November	150	900	0.1
December	180	900	0.1
Total		9,000	1.0

Monthly market wage rates are the supply prices of unskilled labor to the sugar project. Monthly shares (K_i) of the annual person-months required by the project are in column (4).

$$EOCL^u = \sum_{i=1}^{12} (K_i W^u_i)$$

$$= [120*0.2 + 100*0.2 + ... + 150*0.1 + 180*0.1]$$

$$= \$ 141/\text{month}.$$

Project wage (W^u_p) plays no role in estimation of EOCL. Wage paid by project ($180) is a financial cost to the project, and the difference between it and EOCL ($141) is the labor externality ($39) which labor receives as a distributional benefit.

III. Economic Opportunity Cost of Skilled Labor

Skilled workers need to be induced with higher wages to migrate from areas where they are accustomed to better amenities and living conditions. Some items such as housing and food may be cheaper in the rural areas. Thus, increase/decrease in supply price of labor as it moves from the city to countryside depends on the consumer surplus lost or gained.

Case I: Labor Market without Distortions or Regional Migration

If no distortions in the market (income tax) and if working conditions are the same, it is immaterial whether the new workers come from other employments (reduced demand) or from non-market activities (new supply). In both cases EOCL equals local market wage (W^s).

(4) $EOCL^s = W^s$

Case II: Skilled Workers Migrate to Project from Distorted Labor Markets

For each skill type the project pays a wage equal or higher than the supply price (W^s) to attract adequate numbers of skilled workers.

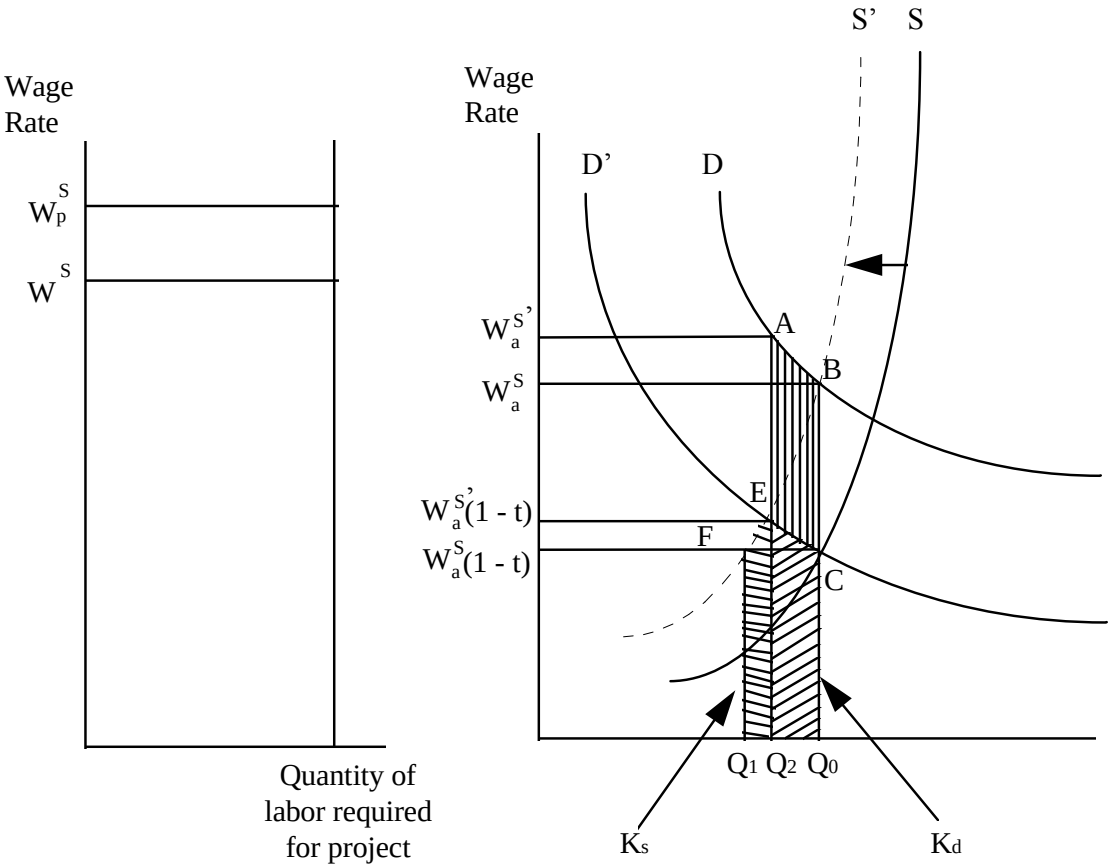
EOCL for each type of labor equals the gross-of-tax supply price to the project of that type, less any taxes now paid by these workers on the project, plus any taxes lost due to movement of labor to project.

Migration of workers from other regions to the project causes labor supply (S) in the sending region to decrease, thus shifting the labor supply curve leftward to the new position S'.

At the original net-of-tax wage for skilled labor ($W^{s}_{a}(1 - t)$) in the sending region, the migration to the project causes a decrease in the available supply from Q_0 to Q_1. For equilibrium in labor market, wage must increase to $W^{s'}_{a}(1 - t)$. This higher wage reduces demand in the sending regions. Higher wage rates induce some skilled workers to enter the formal labor (or overtime) market increasing the quantity of skilled labor supplied from Q_1 to Q_2.

FIGURE 2

REGIONAL INTERACTION BETWEEN SKILLED LABOR MARKETS



MARKET FOR A TYPE OF SKILLED LABOR IN SENDING REGION

$$K_s = \frac{Q_2 - Q_1}{Q_0 - Q_1}$$

$$K_d = \frac{Q_0 - Q_2}{Q_0 - Q_1}$$

The net effect is that if all of the labor for the project migrates from the sending regions, a proportion of the labor (K_S) ultimately comes from the newly induced supply and a proportion (K_d) comes from the reduced demand for workers elsewhere.

Due to reduction in demand of labor, there is a loss of taxes to the government (area bounded by ABCE). To calculate $EOCL^S$, only the tax distortion resulting from reduced demand (K_d) is accounted for. The increased supply (K_S) of labor is coming from market or non-market activities where there are no taxes.

$EOCL^S$ is gross-of-tax supply price (W^s) of workers induced to move to the area minus the difference between the income taxes the workers would pay on this supply price of labor (W^S t) gained by government, and the income taxes previously paid by workers in their alternative employment (K_d W^s_a t), which are lost.

(5) $EOCL^S = W^S - (W^S t - K_d W^s_a t)$

where:

K_d = proportion of the project's demand for skilled labor obtained from taxed employment activities in the alternative labor market

W^s_a = gross-of-tax wage of skilled labor from alternative sources

t = income tax rate levied on skilled workers in all regions

Example 3: Skilled Labor hired for Sugar Production Project

Going back to the example of the sugar project, if the government requires 1,000 person-months of skilled labor per year, project will normally have to attract them from the surrounding urban areas. If these workers earn a monthly gross-of-tax salary (W^s_a) of $900 in the urban area, they will not work for less than $1,200 gross-of-tax wage for the project (W^S). These wage rates reflect the gross-of-tax supply prices of the workers in the two markets. If there is a policy of encouraging more skilled workers to migrate to rural areas, project may be required to pay higher salary (W^s_p) of $1,500 per month, or $300 more than the market supply price. All skilled workers pay 20% of their wages in income taxes.

(1) *Taxes on the Supply Price of Labor*

Taxes on the supply price of skilled labor are calculated as follows:

Taxes on Supply Price = W^S t

=

1,200(0.20) = $240 per month

(2) *Taxes Foregone in Alternative Employment*

Assume that K_d = 0.90 and K_S = 0.10, i.e. approximately ninety percent of the project's skilled labor requirements will be sourced from the decrease in the quantity of labor demanded, while the remaining ten percent will be met through increased labor force participation due to the new project's higher wage. The foregone taxes from the previous employment of the skilled workers are:

Taxes Foregone = K_d W^s_a t

= 0.90 * 900 * 0.20 = $162/month

$EOCL^s = W^s - (W^s t - K_d W^s_a t)$

= 1,200 - ((1,200 * 0.20) – 162))

= (0.90 * 900 * 0.20))

= $1,122/month

Case III: Labor Employed less than Full Year in Market Activities

A worker now spends part of the year in non-market activities. Workers are employed in market activities for a proportion (P_p) of the year if they work for the project and (assuming that $P_p \leq 1$) a different proportion (P_a) of the year if not working on the project.

When the worker is not working in the formal labor market, he is engaged in non-market activities outside the project or in alternative regions, $(1 - P_p)$ and $(1 - P_a)$ portions of their labor time, respectively.

If gross-of-tax supply price of skilled labor in the area of the project is W^S and the alternative wage (reflecting skilled labor's other opportunities) is W^s_a, the $EOCL^S$ is the gross-of-tax expected supply price for skilled labor working a portion of the year in the local market (P_pW^S) that would induce the worker in the project area minus the additional tax payments that the worker has to make when working on this project.

This additional tax is the difference between the tax paid on the project (P_pW^S t) and the tax previously paid in the alternative mix of market activities ($K_dP_aW^s_at$). It is assumed that workers do not pay taxes on non-market activities.

(6) $EOCL^S = P_pW^S - (P_pW^S t - K_dP_aW^s_at)$

Example 4: Skilled Labor Employed Less Than Full-Time in Market Activities

Alternative wage rate for skilled labor is W^s_a = \$600/mo, the project wage is equal to gross-of-tax supply price paid to induce labor to move to the project area ($W^S = W^s_p$ = \$800/mo). The tax rate on skilled labor in all locations is 20%. All of the labor is obtained from alternative employment (K_d = 1), and the proportion of time a skilled worker expects to be employed is P_p = 0.9 in the project area, and P_a = 0.8 in the alternative areas.

$EOCL^S = 0.9(800) - (0.9(800)(0.20) - 1.0(0.8)(600)(0.20))$

$= 720 - (144 - 96)$ = \$672/mo

While the financial cost of labor to fill a job (which employs someone for 90 percent of the year) is estimated, on the average, to be ($P_pW^s_p$) or .9(800) = \$720 per period, we find that the economic opportunity cost of labor is only \$672/mo, or \$48 less than the financial cost. This difference is the net tax gain to the government.